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THE STUDENT'S GUIDE

TO

SURGICAL ANATOMY

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SURGICAL ANATOMY

A DESCRIPTION OF THE MORE IMPORTANT SURGICAL REGIONS OF THE HUMAN BODY, AND AN INTRODUCTION TO

OPERATIVE SURGERY

By EDWARD BELLAMY, F.R.C.S.

HON. FELLOW OF KING'S COLLEGE, LONDON; SURGEON TO, LECTURER ON ANATOMY, AND FORMERLY TEACHER OF OPERATIVE SURGERY IN CHARING CROSS HOSPITAL; LECTURER ON ANATOMY, AS APPLIED TO THE FINE ARTS, TO THE SCIENCE AND ART DEPARTMENT, SOUTH KENSINGTON

BIBLIOTHECA
APR 1880
BODLEIANA

SECOND EDITION, ENLARGED AND REVISED

165 . g . 57 .

LONDON

J. & A. *CHURCHILL, NEW* BURLINGTON STREET

1880

"LES FORMES EXTÉRIEURES, PAR LEURS RELATIONS AVEC LES FORMES INTÉRIEURES, MONTRENT À L'INTELLIGENCE DU CHIRURGIEN, CE QUI EST CACHÉ DANS LA PROFONDEUR DU CORPS, PAR CE QUI EST VISIBLE À SA SURFACE." (*Gerdy.*)

TO

JOHN WOOD, F.R.S.,

SURGEON TO, AND PROFESSOR OF SURGERY IN KING'S COLLEGE,

This small volume is Inscribed,

BY HIS FORMER PUPIL,

THE AUTHOR.

PREFACE TO SECOND EDITION.

A SECOND edition of my manual having been asked for, I trust that in it most of the errors of omission and commission which appeared in the first have been rectified. I have re-written and re-arranged the greater part of it, added more clinical matter, and a larger number of drawings.

The difficulty of condensing such a subject as Applied Anatomy into so limited a compass is immense, and my attempt must merely be considered in the light of a *guide*—I hope a trustworthy one—to the student for his "Pass" examination, offering a series of suggestions to work upon, or an introduction to those more complete works, which I regret to say at present exist only in foreign tongues (Luschka, Hyrtl, Richet, Rüdinger, Tillaux, and others). Should I have the opportunity or leisure, I hope at some future period to elaborate my subject and endeavour to assist in filling up this gap in English literature.

I must acknowledge my indebtedness to these authors, and more especially to Tillaux, whose work I consider the most practical yet produced.

I do not profess to have described all the regions of the body, or to have taken them in strict anatomical sequence, and it will be observed that those portions

of Anatomy, which are more directly associated with "Specialities"—*e.g.*, the eye, the ear, and certain of the viscera—for the present, I consider it advisable either to omit or to touch upon but superficially, referring my readers to works on these particular subjects.

The new wood-cuts are either suggested by or reduced, by permission, from "Braune's Plane Sections of Frozen Bodies," from Henle or Tillaux, to save the great expense of making original preparations, which must of necessity have yielded very like results. I would particularly recommend the careful study of Braune's plane sections to those students who intend presenting themselves for the Fellowship or M.B. examination, and to surgeons and practitioners generally, as being the only work of the kind at present within their reach in English. Braune's work teems with valuable hints, deductions, and applications, of many of which I have availed myself.

The illustrations have been drawn on wood by Mr. Collings and myself.

My best thanks are due to my friend Mr. Johnson Smith, F.R.C.S., Surgeon to the Seamen's Hospital, for his kindness in seeing the volume through the press, and for many valuable hints.

I should be pleased if any physician could be induced to supplement my work by a "Student's Guide to Medical Anatomy," a volume I feel sure is wanted.

EDWARD BELLAMY.

17, WIMPOLE STREET,
December, 1879.

PREFACE TO FIRST EDITION.

A CONSIDERABLE experience as a teacher has convinced me that there is room for a small work on what may be termed Applied Anatomy. With the exception of my friend Mr. Galton's translation of Professor Roser's work, there is no English handbook of the kind within the reach of the generality of students.

Pupils are apt to lay aside their anatomical studies after having passed their "primary" examination, and to be confused at finding a considerable amount of Surgical Anatomy required of them when they present themselves for their final or "pass."

With a view of assisting them, this work has been prepared. A knowledge of Descriptive Anatomy is presupposed, and such regions of the body as do not seem to bear directly upon the operative or more practical parts of Surgery, have been either merely referred to or entirely omitted.

I do not hesitate to state that I have in one or two instances availed myself of methods of arrangement adopted by others; yet all the statements have been confirmed by actual demonstration, and may be regarded as an embodiment of the remarks made to the students attending my course of Operative Surgery at Charing Cross Hospital.

The engravings are, in some instances, borrowed
permission from Mr. Heath's excellent work
Practical Anatomy, or have been drawn upon wo
from nature, by Mr. Wesley, Mr. Sherwin, and mys
or have been adapted from such sources as will
found acknowledged in their proper places.

I have to express my obligation to my friend M
James Cantlie, M.A., F.R.C.S., Demonstrator
Anatomy and now Assistant-Surgeon at Charing Cr
Hospital, for his kindness in revising the proofs, a
for other valuable assistance.

EDWARD BELLAMY.

MARGARET STREET, CAVENDISH SQUARE,
October, 1873.

INTRODUCTION.

As the subject of Regional Surgery and Surgical Anatomy bears directly upon Operative Surgery, it may not be considered out of place to remind the student of the necessity of making most careful inspection of the body as a whole before he attempts he more minute and detailed examination of its arious parts. For this purpose both the living model id the dead subject should be examined together. r such examination the body should be laid on its k—in fact, in the position a patient would be ed in for a surgical examination or operation. the side of the body should be placed an entire ulated skeleton. Careful notice is to be taken l the surface-markings, and of the superficial bear- of all prominent underlying structures, such as subcutaneous surfaces of the bones, ligaments, ns, and bursæ; the proper swellings, or *con- g*, of the muscles, both at rest and in ; the course of the superficial and deep vessels; ange of aspect in regions, dependent upon on of position; the course and direction of eral natural passages of the body; the ana-

tomical relations of the lines of incision required in the various operations of surgery; and the altered positions of dislocated bones as compared with their normal relations.

In studying Regional Anatomy the parts must be regarded as being wounded, either by the surgeon's knife or by some weapon, or displaced by accident. In the various stages of a dissection made in the prosecution of Descriptive Anatomy, it is often the end and aim of the dissector to make a clean or "pretty" preparation, in following out the different vessels, nerves, &c., and for this purpose it is quite right that all pains be taken, but the student must remember that the more he cleans the more he destroys the actual relation of the parts as they would be met with in an operation; and, moreover, he must remember that the very fasciæ he so studiously removes are of the greatest importance in Surgical Anatomy, and that the removal of these structures destroys surgical continuity.

The want of material in our schools is the great drawback to the study of Topographical Anatomy, as bodies cannot be spared for such sections and special examinations as a proper study of the various operative proceedings of surgery suggests.

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ERRATA.

Page 10, line 1, *for* "pro" *read* "pre."

Page 22, line 11, *for* "recto" *read* "recti," and *delete* hyphen.

Page 34, Description of Fig. 8, *for* "maxillaries" *read* "maxillaris," in two cases.

Page 59, bottom line, *for* "axis" *read* "atlas," and *for* "artery" *read* "axis."

Page 60, line 1, *for* "borders" *read* "border."

Page 60, line 2, *for* "vertebræ" *read* "vertebra."

Page 110, line 33, *for* "emphysema" *read* "empyema."

Page 120, line 20, *for* "corresponds" *read* "correspond."

Page 125, line 6 from bottom, *delete* "back of."

Page 253, Fig. 59, scale *should be* "one-third," *not* "one-fifth."

SURGICAL ANATOMY.

CHAPTER I.

SURGICAL ANATOMY OF THE CRANIAL REGION.

THE head is composed of two portions, which may be examined surgically, the Cranium and the Face.

THE CRANIUM.

For surgical purposes the structure of the vault of the skull will suffice for description, since the base is, so far as any operative proceedings are concerned, out of reach, and those contents of the cranial cavity which have any direct relation to practical surgery will receive brief notice in their proper place.

The regions into which the vault of the cranium is divided for the sake of surgical reference, differ in number and extent in the various works upon the subject—thus some authors make four :—the occipito-frontal, the temporal, the auricular, and the mastoid; but for simplicity and more ready reference the following would seem to suffice—viz., the *occipito-frontal* and the *temporo-parietal*.

OCCIPITO-FRONTAL REGION.

The occipito-frontal region is oblong in shape. Its limits are—anteriorly, the superior margins of the orbitar cavities, and *the articulations of* the frontal with the

superior maxillary and nasal bones; posteriorly, the superior curved line of the occipital bone, and on each side the temporal ridge.

Surface markings.—Anteriorly, are the frontal eminences, corresponding with the development of the frontal sinuses; laterally, are the parietal eminences; and posteriorly the external occipital tuberosity, which corresponds with the confluence of the sinuses.

Topography.—The integument is tolerably thick, smooth, and somewhat uneven in surface. It is very rich in sebaceous follicles, and these, by the inspissation of their contents and closure of their excretory ducts, constitute the encysted tumours or *wens* so often met with in this region.

The *superficial fascia* does not exist, the skin being firmly united to the subjacent tissues by numerous trabeculæ, which enclose irregularly shaped nodules of fat, forming a densely lamellated layer. The scalp is highly vascular, and is frequently the seat of aneurisms by anastomosis, erectile tumours, etc.

The musculo-aponeurotic lamina beneath this, is the occipito-frontalis muscle, which consists of two muscular bellies, which are situated in the anterior and posterior portions of this region, the anterior occupying the entire forehead, being attached to the superciliary ridge and nasal bones, and sending a slip downwards to the pyramidal muscle. The posterior is rather larger, and is attached to the superior-curved line, together with the tendinous expansion which is intermediate between these muscular masses. This expansion is called the *epicranial aponeurosis.* This aponeurosis is extremely thin over the vertex of the cranium, but very thick in the temporal region, and is attached to the superciliary ridge, the zygomatic arch, and to the superior curved line.

A layer of loose *areolar tissue* separates the epicranial aponeurosis from the periosteum, into which effusions of blood may take place, and is the seat of purulent *collections* in erysipelas, or after wounds, a condition

demanding free incision down to the bone. In these cases the effusion can be clearly seen to be limited by the attachments above mentioned of the occipito-frontalis muscle and its aponeurosis. Thus a "black eye" can be produced by a blow on the back of the head, by the gravitation of the blood downwards and forwards into the loose subcutaneous tissue of the forehead and eyelids. This aponeurosis is also more adherent to the bones in old persons, and is always more intimately attached along the sutures. In phlegmonous erysipelas of the scalp the pus burrows under this aponeurosis, so that free incisions down to the bone and counter-openings are necessary.

Beneath this cellular layer is the *pericranium* or *external periosteum*, which is much stronger in the child than in the adult: it is frequently the seat of periostitis and nodes. The pericranium seldom reproduces bone after trephining. In scalp wounds the greatest care must be taken to replace the tissues torn off, although it may be mentioned that denudation of the bone is not necessarily followed by necrosis.

Cephalœmatomata are met with in this region; these are tumours caused by the rupture of some vessel or vessels beneath the pericranium during parturition. This condition must not be confounded with a blood tumour, the result of injury, and which is formed beneath the tendon of the occipito-frontalis muscle, at a lower level in the cranium.

A thin lamina of lax *connective tissue* is met with between the pericranium and the bone. The structure next in order is the bone itself, which will be found described, together with those of the cranium in general.

The arteries supplying this region lie in the subcutaneous tissue, they run towards the centre of the region, and are very tortuous. They are—in front, the supra-orbital, the frontal, and the superficial temporal, thus forming a free inosculation between the internal and external *carotid arteries*. Behind, the occipital and the

posterior auricular branches of the external carotid artery freely anastomose with each other, and with the above-mentioned vessels.

The *superficial temporal artery*, which is easily seen beneath the skin in its tortuous course, is liable to injury, which, in the event of the main trunk being divided, either entirely or partially, may be serious by the formation of a false aneurism from the escape of blood beneath the tissues. In such a case the tumour must be opened and the clot turned out, and *both* ends of the bleeding vessel tied. If the operation of arteriotomy be required, the anterior branch of this vessel is to be the one selected, just at the spot where it begins to be covered by the hairy scalp. In performing this operation a small puncture only is necessary, and when complete, the vessel should be *entirely* divided, so that by the retraction of the cut ends the formation of a false aneurism may be prevented. In such plastic operations as the restoration of the upper eyelid, or in rhinoplasty, the preservation of the supra-orbital arteries is of great importance for the proper nourishment of the flap.

Veins.—The arteries are generally accompanied by small veins; one vessel in particular, the *vena præparata*, which is situated in the middle of the forehead, and is plainly visible during bodily exertion or under excitement, is worthy of note. This vein has been proposed as suitable for venesection.

The nerves supplying the muscles and integument, and which follow the course taken by the arteries are, in front, the supra-orbital and supra-trochlear branches of the frontal, and some few inosculating branches of the facial. These nerves are frequently the seat of neuralgia, and for its relief division of the frontal nerve has been proposed at its point of exit from the supra-orbital notch. It is worth remembering that this notch is generally in a line with the fang of the canine tooth.

Lymphatics.—These vessels correspond with the

arrangement of the veins. The superficial lymph-glands of the scalp are plentiful in the occipital region and along the posterior margin of the sterno-mastoid muscle, and become engorged in cases of injury to the scalp, or in constitutional syphilis.

Structures which would be divided in cutting down upon the bone in the occipito-frontal region.—Skin, subcutaneous cellular tissue, occipito-frontalis muscle, and epicranial aponeurosis, a thin layer of lax cellular tissue, and the pericranium; anteriorly the vessels divided are the temporal, the frontal, and the supra-orbital, with the supra-orbital, supra-trochlear, and branches of the auriculo-temporal nerves, and posteriorly the occipital vessels and greater and lesser occipital nerves.

THE TEMPORO-PARIETAL REGION.

This region may be considered as corresponding with the temporal fossa of osteology. The superior limit of this region is the lateral boundary of the occipito-frontal, and its inferior limit is a line drawn from the external angle of the frontal bone to the mastoid process of the temporal.

Topography. — *The integument and subcutaneous cellular tissue* are pretty much the same as in the preceding region. The *superficial fascia* is here developed, but is very thin and cellular, and the mobility of the skin in this region is due to this fact. The *superficial aponeurosis*, very tough, upon which is the temporal artery, beneath it is an aponeurotic lamina having below it some fat and cellular tissue, and containing the small auricular muscles. The foregoing structures are, it will be observed, either entirely or partially common to this and the preceding region.

The temporal fascia is attached above to the curved line limiting the temporal fossa, by a single lamina, and below to the zygoma. This it does by two distinct processes, the superior of which is attached to the external *lip of the zygomatic* arch, and a deeper,

which is attached along the inner lip. A little fat and cellular tissue lie between them.

Beneath this layer of the aponeurosis is a quantity of *fat*, which, however, is confined to the lower third of the region, separating it from the *temporal muscle*. This muscle corresponds in shape exactly with the fossa, and contains the deep temporal vessels and nerves which enter its deep surface. Below the muscle is the epicranium. The osseous structure of the region will be described in the remarks on the cranium in general.

The *shape* of the zygomatic arch varies in individuals and races; it may be the seat of fracture.

The arrangement of the several aponeuroses in this region determines the course taken by purulent collections, blood, or rapidly growing neoplasiæ. If deep seated, they may make their way into the zygomatic fossæ, and so into the orbit, pterygoid region, or pharynx, and if superficial they would be limited by the more superficial aponeuroses.

Arteries.—The arteries of this region may be conveniently regarded as divisible into three groups—superficial, intermediate, and deep; the former, the superficial temporal, have been already alluded to. The intermediate are the deep temporal, which, derived from the internal maxillary, enter the under surface of the temporal muscle, are distributed to it, and inosculate with the superficial. The *deep* vessel of the region, separated from the foregoing by the skull itself, the middle meningeal necessarily belongs to this region, as any wound, fracture, or surgical operation, such as trephining, would perhaps involve it. This vessel has the following relations with regard to the surface of the cranium: if an imaginary line be drawn horizontally backwards from the external orbital process, the course of the middle meningeal artery would be found in this line about four-fifths of an inch behind it.

The posterior part of this region, which contains the

mastoid process of the temporal bone, is by some authors described as a distinct one. The external aspect of this process is almost entirely subcutaneous, and is a sort of *point de repère* of the tissues belonging to the occipito-frontal region. The periosteum is very thick, giving attachment to the sterno-mastoid, occipito-frontalis, splenius, and trachelo-mastoid. Surgically it is the seat of an operation proposed for the opening of the mastoid cells, with the object of giving vent to matter pent up in them, should it not find its way either by the Eustachian tube or through the external auditory meatus. The deeper portions of this region will be discussed further on. It must be borne in mind, with regard to the surface, that beneath this process we come upon the dura mater and lateral sinus.

The structures divided in cutting down upon the bone in the temporo-parietal region are—the skin, subcutaneous fascia, epicranial aponeurosis, superficial temporal aponeurosis, deep temporal aponeurosis, temporalis muscle and tendon, with the superficial and deep temporal vessels, nerves, and lymphatics, and periosteum.

SURGICAL ANATOMY OF THE BONES OF THE CRANIUM.

The structure of the cranial bones forming the vault of the skull in the adult consists of three layers: an outer, formed of tough compact tissue; an intermediate, the diploë, soft and spongy, having the diploic veins ramifying in its substance; and an inner, hard and brittle. These diploic veins communicate by a number of apertures, both with the sinuses of the dura mater and the tegumentary veins; these are called the *emissary* veins. Hence a direct communication is kept up between the venous system without and within the cranium. This direct anastomosis explains the mutual relations of inflammation of the integuments *and the meninges,* the existence of embolism

or thrombosis of the sinuses after anthrax of the neck or face. Again, after injury followed by suppuration, they are liable to inflammation; which explains the formation of secondary deposits of pus in various parts of the body, most frequently in the lungs and liver. The brittleness of the internal layer is of surgical importance, from the fact that, in blows on the head, it is more liable to be fractured than the outer; and cases have occurred where it has been

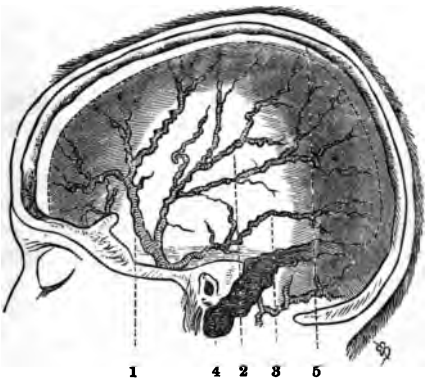


Fig. 1.—Diagram of Structures to be avoided in use of Trephine.

1, 2, 3, branches of middle meningeal artery; 4, lateral sinus; 5, superior longitudinal sinus.

broken without any apparent depression whatever of the external, giving rise to symptoms of compression, which would otherwise have been difficult of explanation. The diploë is not easily distinguished in young persons. In the application of the trephine, the varying densities of the layers of the skull must be borne in mind, as the pressure upon the instrument on its first application should be firm and steady, until the external table is perforated, when there is less *resistance.* When this is quite perforated the blood of

the diploë will be seen in its teeth. This, however, is not always the case, as the bone dust is stained with blood from the outset of the operation. The pin of the trephine is now to be withdrawn, to avoid its being pushed through the inner table into the dura mater and encephalon; the inner table, though thinner, will be found to offer more resistance to the saw edge. There are certain localities in the skull where the application of the trephine should be avoided. These are—over the longitudinal sinus, the anterior inferior angle of the parietal bone, because of the middle meningeal artery, over the occipital tuberosity, and over the sutures. It is advisable to avoid trephining over the sutures, on account of the passage of the emissary veins and entrance of arteries.

Relations of the cerebrum to the cranium.—The topographical relations of certain portions of the cerebrum with the cranium are of great importance in the diagnosis of the exact position of abscess, or of the nature of the depression of the bone in injury, and the subsequent application of the trephine. It has been thought advisable to give certain measurements, which have been determined by Broca, Turner, and others, as guides for this operation.

The fissure of Sylvius divides into two branches, corresponding with the summit of union of the greater wing of the sphenoid with the temporo-parietal suture, and is normally situate about half-an-inch behind the fronto-parietal suture. The anterior branch is parallel to the fronto-parietal suture, or may be rather higher and parallel, and then passes upwards and backwards, terminating in the semi-circular cranial line.

The fissure of Rolando, as regards its superior portion, is situated about 2 inches behind the fronto-parietal suture, and is directed downwards and forwards, and its inferior portion lies about 1·2 inches behind the fronto-parietal suture, and from about $\frac{1}{12}$ to $\frac{1}{4}$ of an inch higher than the commencement of the temporo-parietal suture.

The pro-central sulcus which skirts the anterior border of the ascending frontal convolution is situated

Fig. 2.—Relations of the Fissures and Convolutions of the Left Hemisphere of the Brain with the Skull. (One-third.)

The fine line indicates the contour of the skin, the pointed lines the contour of the bone, the sutures, and semi-circular line, the thick lines the contours of the brain and fissures. *S*, the fissure of Sylvius; *S'*, its horizontal portion; *S''*, its ascending portion; F^1, F^2, F^3, the superior, middle, and inferior frontal convolutions; f^1, f^2, f^3, superior, inferior, vertical frontal sulci; *A*-*B*, ascending frontal, ascending parietal convolutions; *c*, fissure of Rolando; P^1, superior parietal convolution; P^2, marginal convolution; $P^{2'}$, curved convolution; *ip*, interparietal fissure; O^2, O^3, second and third occipital convolutions; o^2, inferior occipital convolution; T^1, T^2, T^3, inferior middle and inferior temporal convolutions; t^1, t^2, superior and middle temporal sulci; *I*, Island of Reil; *Cb*, cerebellum.

below at about $\frac{2}{3}$ of an inch behind the coronal

suture, and above at a distance varying between $\frac{4}{5}$ and $1\frac{3}{5}$ inches. The inter-parietal commences above the transverse branch of the fissure of Sylvius $\frac{3}{5}$ or $\frac{4}{5}$ of an inch behind the inferior extremity of the fissure of Rolando.

The point where the internal perpendicular fissure unites with the external perpendicular fissure generally corresponds with the union of the sagittal and lambdoidal sutures. The external perpendicular fissure corresponds with the lambdoidal suture, or crosses it.

The anterior, inferior, and median summit of cerebral hemisphere corresponds with the middle of the mesial line between the naso-frontal suture, and the line which joins the upper border of the orbits. The inferior border of each hemisphere is directed outwards, almost parallel with the superior border of the orbit, and separated from it about $\frac{1}{5}$ of an inch.

The vertical distance between the inferior border of the frontal lobe, and the angle formed by the superior border of the zygoma, is generally about $1\frac{2}{5}$ of an inch.

The inferior external limit of the parietal lobe corresponds very nearly to the line which unites the superior part of the parieto-temporal suture with the summit of the lambdoidal. The inferior border of the occipital lobe corresponds to the line uniting the external angle of the occipital with the occipital protuberance.

Below this line is the cerebellum. The anterior border of the temporal lobe is situated about $\frac{1}{5}$ of an inch external to the outer margin of the orbit. The inferior border of the temporal lobe at the spot where it is continuous with its anterior is distant from the zygomatic arch about half-an-inch, nearer the articulation of the lower jaw it is about $\frac{1}{5}$ of an inch distant from it.*

The arrangement of the various *sutures* of the bones forming the vault of the cranium has greater interest for

* Broca: "*Sur la Topographie* Cranio-Cérébrale," etc.

the obstetrician than for the surgeon, as any peculiarities connected therewith exist normally only in fœtal life or in early childhood. The bones of the skull in the fœtus or newly-born child are flexible, and between their undeveloped sutures are the *fontanelles*, the positions of which are of importance. At birth only the large quadrilateral frontal fontanelle exists. It is rhomboidal in shape, with irregular sides, of unequal length, and bent inwards. The two anterior borders are the longer, and the angle between them is more acute than between the posterior; consequently the position of the child's head (the *presentation*) can be readily made out during parturition. The triangular fontanelle is not open in the child at full term, nor the lateral fontanelle, which is of no practical importance. They are generally completely ossified at the fourth year.

Fracture by *contre-coup* is denied by some, on the ground that the shock is resisted by the cranium, and that the results of such shocks, as in the case of architectural arches, are lost upon its supporting pillars, which, in the frontal region, are represented by the malar and sphenoid bones, in the parietal by the temporal bones, and in the occipital region by the ribs of the occipital bone itself. Rupture of the brain substance, however, is common by *contre-coup*.

In almost all cases, when the parietal region is the seat of the injury, the bone is fractured at the spot, and the line of fracture runs through the temporal bone, which, from the fact of its containing so many cavities and foramina, its texture, and the inclination of the axis of the petrous portion, readily gives way.

A fracture of the base may also occur from a fall on the feet or on the buttock, the force being transmitted along the spinal column, and meeting the skull at the condyles. The course of such fractures of the base may be anatomically determined by the effects produced upon the nerves issuing from the skull, the

most frequent being facial paralysis from lesion of the portio dura whilst in the aqueductus Fallopii.

Fractures of the base of the cranium are generally associated with ecchymosis of the eyelids and effusion of blood and cerebro-spinal fluid from the external auditory meatus. Although ecchymosis of the eyelids has been described as of great symptomatic value in such cases, it has also been shown that the orbital effusion is preceded by ecchymosis of the ocular conjunctiva. When in fact in a fracture of the cranium the effusion of blood produced by the rupture of the blood-vessels of the diploë reaches the roof of the orbit, it rapidly infiltrates the cellular tissue of this cavity, and passing through the perforations in the capsule of Tenon, invades the sub-conjunctival cellular tissue. Orbitar ecchymosis by infiltration of blood after contusion of the eyelids is not produced in the same manner (*vide* "Orbit").

The surgical anatomy of the *temporal* bone presents considerable additional points of practical importance, as it contains the organ of hearing and the parts accessory to it.

The *external auditory canal* has a direction inwards and forwards, describing a slight general curve, the concavity of which is downwards. The outer third of the passage is formed by a tubular prolongation inwards of the cartilage of the external ear, which, however, is not complete at the upper part; and its inner two-thirds by the canal in the temporal bone. There are several small fissures in the cartilaginous part, which are sometimes very wide — a circumstance explaining the passage of pus *into* the meatus, from abscesses which have formed *without* to it. In length the meatus is about an inch and two or three lines; but owing to the obliquity of the attachment of the membrana tympani, its anterior wall is about one-quarter of an inch longer than the posterior. Its narrowest diameter is about the middle, and in making an examination with *the speculum auris* the instrument should not

be introduced further than this point. It must be borne in mind that in young children the meatus is very shallow, the bony part consisting only of a small ring of bone, deficient at the upper part, to which the membrana tympani is attached.

To facilitate the introduction of the speculum, the

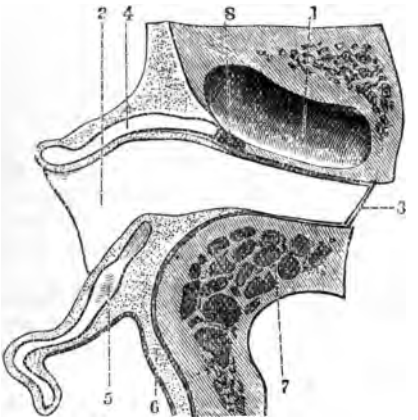


Fig. 3.—Horizontal Section of the left External Auditory Canal. (Actual size.)

1, glenoid cavity of temporal bone; 2, external auditory meatus; 3, membrana tympani; 4, 5, cartilaginous portion of external auditory meatus; 6, periosteum of mastoid bone continuous with that of the auditory canal; 7, mastoid cells; 8, fibrous tissue, which unites the cartilaginous with the osseous tissue of the canal.

auricle should be drawn upwards, backwards, and a little outwards; this renders the canal tolerably straight.

The *membrana tympani* is, on examination, greyish in colour, its fibrous structure looking radiated, slightly conical, with the apex directed inwards, and placed very obliquely at the bottom of the meatus. The handle *of the malleus* is seen through the membrane, not quite

vertical, but inclining a little backwards. The points of practical importance connected with the *tympanum* are these—that its upper aspect and floor are formed by thin lamellæ of bone separating it from the cranium and from the canal for the internal carotid artery, so that disease of the bone may cause death, either by involving the dura mater and brain, or from ulceration into the vessel. The close vicinity of the carotid artery and lateral sinus readily accounts for the escape of blood from the ear in fracture of the base of the cranium.

The *Eustachian tube* is the means of communication between the internal ear and the pharynx, and serves to maintain the balance of air on either side of the membrana tympani.

Its internal orifice is at the anterior internal aspect of the tympanum. The tube is directed downwards and forwards, and terminates in a flattened valve-like opening in the pharynx, just behind and a little above and external to the inferior meatus of the nose. Its mucous membrane is continuous with that of the pharynx. The pharyngeal extremity of the tube is in close relation with the tonsil—a fact which explains its temporary occlusion in enlargement or inflammation of that gland (*vide* " Pharynx ").

(The operation of introducing the Eustachian catheter is explained at p. 41).

SURGICAL ANATOMY OF THE FACE.

The region of the face is naturally very complicated, but it will be found that its subdivisions may be conveniently referred to its skeleton; and after describing the surgical anatomy of the integuments of the face, it will be advisable to examine its several subdivisions, as follows:—The region of the orbit, the nose, the mouth, the pterygo-maxillary, and the parotid regions.

Topography.—The skin of the face is remarkably thin, *freely supplied with vessels*, nerves, and lymphatics.

The subcutaneous cellular tissue is dense, and contains (except on the eyelids) a good deal of fat.

Blood-vessels.—The arteries of the face may be regarded as forming two overlying networks, one a superficial and distributed essentially to the integument, and the other a deep. The several vessels entering into its formation will be considered with the special regions to which they respectively belong.

The superficial supply of the face is derived from the external carotid, by the facial, and from the ophthalmic branches of the internal carotid. The deep is formed by the lingual, pharyngeal, internal maxillary, and ophthalmic. Their inosculation with the superficial set is remarkably free, and forms an intermediate means of communication with the intra-cranial arteries, through the middle and lesser meningeal and the ophthalmic.

The normal course of the facial artery, when it appears on the face, is just anterior to the masseter muscle, where it is subcutaneous, and here only is it in actual relation with the accompanying facial vein, which is almost straight, and lies to its outer side. The vessel ascends from this point tortuously, particularly so in old persons, towards the corner of the mouth, side of the nose, and inner angle of orbit, where it inosculates with the ophthalmic. The artery lies at first under the platysma, and further on in its course is covered by some thin fibres of the zygomaticus major. The chief named branches are the inferior labial, running between the lower lip and the chin, and distributed to its integument; the coronary, superior and inferior, distributed to each lip and to the septum of the nose; the lateral nasal, to the side of the nose; and the angular, a large branch going to the inner angle of the orbit, generally seen pulsating under the skin. The transverse facial artery is a branch generally of the temporal, lying by the side of the duct of the parotid gland (Steno's), accompanied by branches of *the facial* nerve.

Those branches which the internal carotid supplies to the face are the terminal ones of the ophthalmic—namely, the supra-orbital and supra-trochlear which escape by the supra-orbital and supra-trochlear notches. The inosculating vessels escape through several foramina in the bones of the face, from deep branches of the external carotid—viz., the infra-orbital, passing out of the infra-orbital foramen; from the mental foramen, and a large branch from the same source is found on the substance of the buccinator. The free inosculation of the arteries of the face renders ligature of both ends of a divided facial artery necessary, as the return circulation is quickly established; and, in wounds, whether the results of accident or surgical interference, very accurate approximation of the edges must be obtained, for union takes place very rapidly, and distortion is not so easily remedied. The *veins* of the face are arranged like the arteries, in two networks, and freely anastomose with each other and the opposite side, and with the intra-cranial system. The angular veins freely inosculate with the ophthalmic. The veins which accompany the internal maxillary (*vide* "Internal Maxillary Region"), form a remarkable plexus, and being intimately associated with the aponeuroses of the region, remain open when cut. The blood-vessels of the face are frequently subject to a nævoid condition.

The *nerves* of the face are derived from the three divisions of the 5th, and from the portio dura or facial part of the 7th cerebral nerve. The branches from the 1st division of the 5th are—the supra-orbital, supra-trochlear, infra-trochlear, lachrymal, and nasal. From the 2nd—the infra-orbital, passing out of the infra-orbital foramen, and the subcutaneous malæ. The buccal from the same source emerges just in front of the anterior border of the masseter. From the 3rd division—the masseteric, and the inferior dental from the foramen mentale. Physiological experiments have determined that the 5th, by its ophthalmic and superior maxillary branches, *is exclusively* sensory, whilst by

its inferior maxillary branch it is both sensory and motor, and that the sensory fibres of the nerve preside over the secretion and nutrition. It is, moreover, associated with the pharyngeal plexus in the sense of taste, and all its branches are endued with acute sensitiveness.

The facial forms a plexus in the parotid gland, after which it passes into a great many branches, and is supplied to the muscles of the face, having free inosculations with the branches of the 5th nerve. The facial nerve is itself insensitive, and does not convey any sensitive impression to the cerebrum; it is a motor nerve, and by virtue of its motor function it exercises a certain influence upon the organs of sense and accessorily on the secretions, on the temperature, circulation, and nutrition of the face.

The *lymphatic glands* of the face are most thickly situated along the base of the jaw, upon it and the buccinator muscle, others under the zygoma, and beneath, in, or upon the parotid gland; those around the mouth are sometimes affected with syphilitic induration after the application of the specific virus to the lips.

The cellular tissue being very lax, and loosely attached to the subjacent structures, it is liable to infiltration by fluids, or air, as in wounds of the frontal sinuses or larynx. As the fasciæ of the face are very thin and ill defined, abscesses in this region point early.

The congenital malformations consist of closure of its apertures, arrests of development, such as single and double hare-lip, frequently associated with cleft-palate.

Some portions of the parotid gland (anterior portion and socia parotidis) are of importance in the consideration of the integuments of the face, inasmuch as they are subcutaneous, and would be implicated in the removal of growths, abscesses, and in operations for salivary fistulæ. The facial portion of the gland is *situated just* in front of and below the ear, the deeper

portion lying behind the angle of the jaw, limited above by the zygoma (*vide* "Parotid Region"). It overlaps the masseter to a variable extent. Its *duct* runs forward to the anterior edge of the masseter, and dips inward to open obliquely through the cheek, opposite the second molar tooth of the upper jaw. The *course of Steno's duct* is defined by a line extending from the upper border of the lobule of the ear to midway between the nostril and the angle of the mouth; and great care must be taken in operations on the face to avoid its division, as a salivary fistula would be the result.

SURGICAL ANATOMY OF THE REGION OF THE ORBIT.*

The region of the orbit may be conveniently described as consisting of an external and an internal. The external comprises the superciliary, palpebral, and lachrymal apparatus; and the internal the muscles, vessels, and nerves of the orbit, and the globe of the eye.

Topography.—The superciliary region, consisting exclusively of the eyebrow, and presenting for examination the skin, which is covered with hair, its deep surface being attached to the corrugator supercilii. The incision for an operation, such as removal of a cyst, should be made parallel to its general direction, after shaving the eyebrow. The subcutaneous cellulo-fatty layer is dense and adherent. The muscular layer consists of the orbicularis frontalis and corrugator supercilii, very thick, the submuscular cellular tissue, which is continuous with that of the occipito-frontalis, and the periosteum, which is continuous with that of the orbit. The bony plan is the frontal bone.

* The minute anatomy of the eye has been omitted, and such portions only described as are associated with the more ordinary operations.

The small dermoid cysts met with at the extern angle of the brow are the results of the imperfe closure of the first branchial arch; they are alway congenital and always adherent to the bone.

The palpebral region.—This region is formed e clusively by the eyelids.

In the following description of the orbital regio those parts only which are the seat of the ordinar surgical operations are treated of. An account c those parts which are contained within the globe, an of the operative proceedings connected with them i necessarily very short, and the student is referred t works on descriptive anatomy or ophthalmic surgery as the limits of the present volume scarcely admi of so special a subject.

THE EXTERNAL ORBITAL REGION, SUPERCILIARY AND PALPEBRAL.

The eyelids consist of the following layers:—Th skin, which is remarkably thin, and presents trans verse folds which are formed by the movements o the lids. Incisions into the lids should always b made parallel to these folds. Next in order is the sub cutaneous cellular tissue, very loose, and destitute o fat, continuous with that of the forehead, and ver liable to infiltration of blood if the effusion take place beneath the tendon of the occipito-frontali muscle, the insertion of the tendon of which (tend oculi), is of some surgical importance. It passes in front of the middle lachrymal sac, tying it down in it place, whilst a second lamina passes behind it. It position is readily shown by placing the fingers on the upper and lower lids and gently drawing them outwards; it thus forms a guide to the lachrymal sac.

Beneath the muscular layer is some very lax cellular tissue, which is readily infiltrated by serum, blood *or air,* producing ecchymosis or emphysema. Nex

in order is a fibro-cartilaginous layer, formed by the tarsal cartilage and tarsal ligament, which attaches the cartilage to the margin of the orbit. The Meibomian follicles lie in the posterior aspect of these cartilages. The tarsal ligament generally prevents ecchymosis, dependent on fracture at the base, becoming subcutaneous. The tarsal cartilage of the upper lid is strengthened by the insertion into it of the levator palpebræ.

The next layer is formed of cellular tissue and fat, particularly developed at the orbital border of the lids, where it is continuous with that of the orbit. The most internal layer is the conjunctiva.

The *palpebral conjunctiva*.—The conjunctiva is the mucous layer of the eyelids; it is intimately adherent with the posterior aspect of the tarsal cartilages. It is continuous with the skin at the free border of the lids, and at about the junction of the inferior three-fourths of the tarsal cartilage with the upper. It is deflected on the sclerotic, forming above the superior oculo-palpebral cul-de-sac and below the inferior, which is shallower than the superior. The spaces above and below the cul-de-sac are filled with lax cellular tissue, into which the blood finds its way after flowing into the orbit. Should this effusion appear some while after an injury to the head, it indicates the existence of a lesion more or less distant from the point of its appearance, and which is generally a fracture of the base of the skull passing through the body of the sphenoid bone. This is a point of the greatest importance in diagnosis after injury to the head.

The arteries consist of the palpebral branches of the ophthalmic which anastomose with the facial, temporal, infra-orbital, supra-orbital, and lachrymal. The veins, as a rule, accompany the arteries. The nerves are derived from the facial, the superior maxillary of the fifth and the third, which supplies also the levator palpebræ.

The *ocular conjunctiva* after its reflection over the

eyeball, becomes transparent, and its blood-vessels ar invisible, unless conjunctivitis is present. These vessel are arranged as a network over the entire surface of th globe, and can be caused to slide over the subjacen cornea or sclerotic, owing to the cellular membran existing between them. It will be observed, in the in flammatory condition, that the direction of the blood vessels of the sclerotic is arranged radially, and the are pinkish in colour, owing to their lying in its dens substance, whereas the conjunctival vessels are scarlet The recto-tendons are separated from the ocular con junctiva by a layer of connective tissue, and the ocula prolongation of the capsule of Tenon.

The free border of the lids presents the orifices of the Meibomian and ciliary follicles, and their outer margin the cilia. The Meibomian glands are about thirty or forty in number, having corresponding ducts on either side of which open a number of small cul-de sacs. The office of their secretion is to prevent adhesion of the eyelids ; the ciliary follicles are subject to dilata tion and suppuration, forming *stye*. The commissure of the eyelids differ in form, the conjunctiva forming a small cul-de-sac externally, whilst internally is found the caruncula, having to its outer side the plica semi lunaris.

LACHRYMAL APPARATUS.

The lachrymal apparatus—including the lachryma gland, the lachrymal ducts, the conjunctival surface o the eyeball, the puncta lachrymalia, the canaliculi, th lachrymal sac and its duct (nasal duct)—is situate partially within the orbital cavity, partially in the eye lids, the inner canthus, and partially in the nose.

The lachrymal gland lies in a depression situated a the external and superior aspect of the orbital fossa. It is enclosed in a fibrous capsule, which is derive from the periosteum of the orbit, and generally consist of two portions—an orbital, the larger, and an anterio *or palpebral ;* the outer margin of the aponeurosis of

the levator palpebræ muscle forming a partial separation of these two portions. *Its relations* are as follows :— *Superiorly*, the periosteum of the orbit; *inferiorly*, the eyeball, and superior and external recti muscles; *anteriorly*, it is closely adherent to the posterior

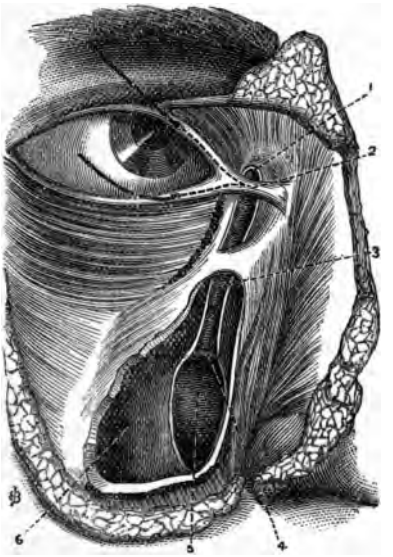


Fig. 4.—Lachrymal Apparatus and Nasal Duct.
1, lachrymal sac; 2, tendo-oculi; 3, valvular folds in nasal duct; 4, orifice of nasal duct; 5, lower turbinated bone; 6, inner wall of antrum. (Bristles are introduced into the puncta lachrymalia.)

aspect of the upper lid and conjunctiva. *Within* it, is the lachrymal branch of the ophthalmic artery, inosculating with the orbital branch of the internal maxillary, with their accompanying veins; the lachrymal branch of the ophthalmic division of the fifth nerve, which inosculates *with the* orbital branch of the supe-

rior maxillary division of the fifth. These stru
enter at its posterior and external margin. The
of the lachrymal gland, which are about ten in nu
are so arranged that they open in a row in the su
external conjunctival cul-de-sac.

The lachrymal canals commence at the *puncta lachrymalia*, which are seen, on everting the lids, a
centres of small eminences, situated about a quar
an inch from the inner angle, on the inner asp
the margin of the lid. These minute openings ar
in contact with the conjunctival surface of the
by the action of the tensor tarsi, so that they a
lie in the current of the tears. In each canali
immediately below the punctum, is a small cul-d
beyond which, after enclosing the caruncula, the
join previous to entering the lachrymal sac.
posterior portion is subconjunctival, a circumsta
considerable practical value in the operation
instating the course of the tears when from any
the orifices of the puncta do not perform their fu
of receiving the tears. That portion which is co
to both canaliculi is bound down by the tendo
The process by which the continuous flow of
between the lachrymal gland and the nose is ke
is not entirely clear; it is very probably in a
measure owing to suction caused by exhaustion i
nasal duct.

The lachrymal sac is the superior dilated extr
of the nasal duct (*vide* "Nasal Region"), and co
of fibro-elastic tissue, lined with epithelium, conti
through the puncta with the conjunctiva, and by
of the nasal duct, with the mucous membrane
nose. It is situated at the internal angle of th
and is lodged in a hollow formed by the os ungu
the nasal process of the superior maxillary.
covered in by the skin, subcutaneous cellular t
tendon of orbicularis muscle, and the internal p
of the palpebral aponeurosis. The exact situat
the sac can be felt with the finger, and the best

mark is the anterior lip of the lachrymal groove, surmounted by a small tubercle of bone, formed by the external border of the nasal process of the superior maxilla, or if both the lids be abducted from the mesial line, tension is made on the tendo-oculi, which

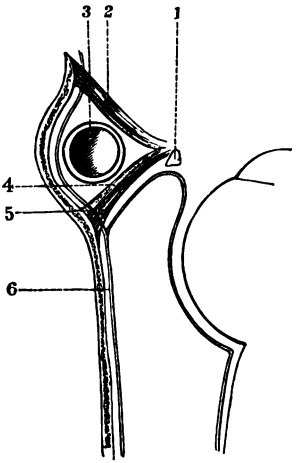


Fig. 5.—Diagram of the Relations of the Lachrymal Sac, by a horizontal section taken at the level of the inner angle of the eye.

1, caruncle; 2, direct tendon of orbicularis muscle; 3, lachrymal sac; 4, reflected tendon of orbicularis muscle; 5, Horner's muscle; 6, periosteum lining the wall of the orbit and the lachrymal canal.

will show itself as a flat cord immediately over the sac bisecting it.

To introduce a probe into the nasal duct by the punctum lachrymale.—It is frequently necessary to pass a probe into the nasal canal through the punctum; the lower lid is to be everted, when the punctum will be seen about two lines from the inner angle on a small papilla. The probe *is first* to be introduced vertically, *and pushed downwards* for a short distance, when the

hand is to be depressed, and the probe pushed inwa
until arrested by the os unguis, then raised again v
tically; when the slightest pressure will cause it
traverse the lachrymal sac and enter the nasal ca
pushing it downwards, backwards, and inwards.

When suppuration takes place in the lachrymal s
and ulceration through the integument follows, *lacl
mal fistula* is the result.

The tears may be prevented passing into the pun
owing to these being obstructed, or to eversion of
lid from some cause, such as ectropion, as a resul
a burn or other injury, or cicatrization after syphil
ulceration, or paralysis of Horner's muscle.

INTERNAL ORBITAL REGION.

Boundaries.—The bony walls of the orbit are forn
as follows:—

The roof, very thin except at the base, conca
directed downwards and forwards, by the orbital pl
of the frontal bone in front, and by the lesser wing
the sphenoid behind; externally is the depression
the lachrymal gland. *The floor*, very thin, nearly f
by the malar, superior maxillary, and orbital plate
palate. *Outer wall*, concave by the greater wing
sphenoid and malar bone. *Inner wall*, flat, by
lachrymal, os planum of ethmoid, and sphen
Regarding the shape of the orbit as nearly coni
its base is nearly quadrilateral, and at its sev
angles are found the sutures of its component bo
At its external, that of the external orbital pro
of the frontal with the malar; at its internal, t
of the frontal with the lachrymal and nasal pro
of superior maxilla; below, that of the malar with
superior maxilla.

Its apex corresponds to the optic foramen
sphenoidal fissure.

The spheno-maxillary fissure is found on the fl
of the orbit. The continuity of this fissure with

spheno-maxillary fossa explains the protrusion of the eyeball from processes of tumours passing through it from the spheno-maxillary region.

CONTENTS OF THE ORBITAL CAVITY.

The soft parts of the orbit are contained within two distinct compartments, separated from one another by

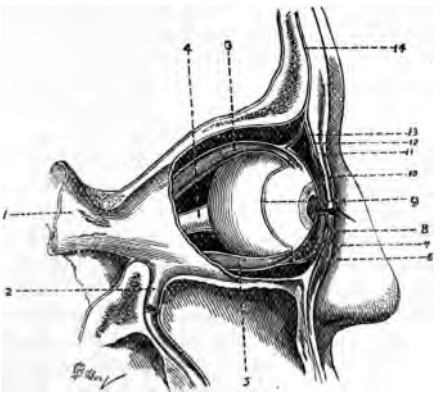


Fig. 6.—Aponeuroses of Orbit.

1, dura mater; 2, prolongation of dura mater into the posterior palatine canal; 3, superior rectus enclosed in its sheath; 4, optic nerve; 5, inferior rectus in its sheath; 6, process of aponeurosis of inferior oblique attached to the palpebral aponeurosis; 7, inferior oculo-palpebral cul-de-sac; 8, inferior tarsal cartilage; 9, ocular portion of orbito-ocular aponeurosis; 10, superior tarsal cartilage; 11, palpebral aponeurosis; 12, superior oculo-palpebral cul-de-sac; 13, process of aponeurosis of superior oblique attached to the palpebral aponeurosis; 14, periosteum of frontal bone continuous with that of the orbit.

the *orbital aponeurosis*, or capsule of Tenon. The anterior of these compartments contains the eyeball, and the insertions of the muscles of the globe, the posterior the muscles themselves, the vessels and nerves, and *the fat and cellular tissue* of the orbit.

The dura mater enters the cavity by the optic foramen and anterior lacerated fissure forming the periosteum. At the margin of the orbit it splits into two layers, one continuous with the pericranium at the upper margin of the circumference, or with the periosteum of the face at the lower, and the other which forms the capsule of Tenon. The vertical portions of this orbital aponeurosis form the superior and inferior oculo-palpebral cul-de-sac, and the lateral strengthen the palpebral ligaments. It is then reflected over the posterior portion of the globe, enclosing the optic nerve, and furnishes sheaths for the muscles. This aponeurosis is pierced by the vessels and nerves which pass from the posterior to the anterior compartment. A knowledge of the arrangement of these aponeurotic expansions and of their situations is of some considerable importance in the diagnosis of intra-orbital injury or disease, as by their attachment and situation they facilitate or impede the course taken by blood or pus. Ecchymosis beneath the conjunctiva is an important symptom of fracture of the roof of the orbit after injury of the head. *The muscles* which act upon the globe are six in number—namely, the four recti and two obliqui, and one muscle acting upon the upper lid, the levator palpebræ. At their insertion their tendons become expanded upon and continuous with the sclerotic. The complete division of the aponeurotic sheaths as well as of the tendons is necessary in the operation for strabismus, as these investments, if left undivided, still exert considerable power over the globe, owing to their completely enclosing both muscle and tendon. The recti tendons are inserted into the sclerotic about a quarter of an inch behind the cornea.

The eyeball and its vessels and nerves lie in a mass of fat and cellular tissue, which serves as a cushion for the optic nerve and for the globe in its various movements, and as a support for its accessory structures. This cellulo-fatty mass is continuous with the

cranial cellular tissue, and with that of the zygomatic and spheno-maxillary fossæ.

The arteries are derived from the ophthalmic branch of the internal carotid, which enters the optic foramen below the nerve, and forms free anastomoses with the temporal, facial, and internal maxillary.

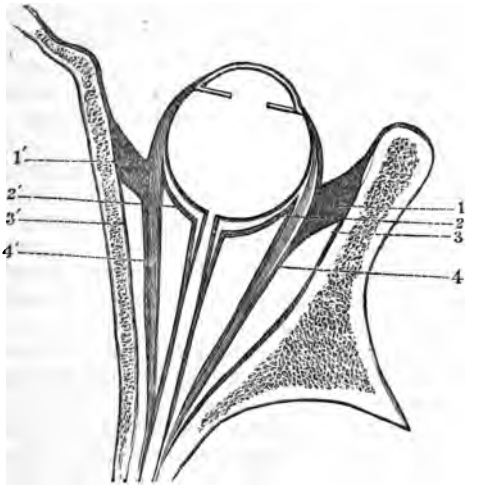


Fig. 7.—Diagram of a horizontal section of the Orbit, showing the lateral prolongations of the Orbital Aponeurosis.

1, internal prolongation; 2', external prolongation; 2-2', ocular lamina of the orbital aponeurosis; 3-3', orbital periosteum; 4-4', lateral recti-muscles.

The veins generally accompany the arteries, and terminate in a large vein, the ophthalmic, unprovided with valves, which, after being formed both without and within the orbit, passes as a trunk between the two heads of the external rectus muscle, and enlarges into the cavernous sinus.

The nerves are—the optic, the third, the fourth, the *ophthalmic division of* the fifth and the sixth, with

their branches, and from the lenticular ganglion are given off the ciliary (short).

Paralysis of the third nerve or motor-oculi causes *ptosis*, or a dropping of the upper lid, external strabismus, dilatation, and immobility of the pupil. Paralysis of the fourth nerve, or patheticus, causes impossibility of rotation of the eyeball, and diplopia; paralysis of the ophthalmic branch of the fifth nerve produces alternately sloughing of the cornea; in paralysis of the sixth, or abducens, the eyeball is turned inwards, and in paralysis of the seventh, or facial nerve, there is impossibility of closure of the eyelid and epiphora.

Relations of parts within the orbit.—A good idea of the actual relations of the contents of the orbital cavity looked upon as a cone may be obtained by regarding the eyeball and optic nerve as occupying very nearly its axis, and the muscles, vessels, and nerves as placed superiorly, inferiorly, externally, and internally to them.

The *relations* of the globe and optic nerve to the orbital cavity, and considered as occupying its axis, are as follows:—

Superiorly, from above downwards (omitting the dura mater):—(1) The frontal vessels and nerves, and behind in the same plane the fourth nerve; (2) the levator palpebræ muscle; (3) the rectus superior; (4) the superior set of the muscular branches of the ophthalmic artery, and the superior division of the third nerve; (5) the nasal nerve and ophthalmic artery, and the ciliary vessels and nerves.

Inferiorly, from below upwards:—(1) The inferior rectus and the inferior oblique muscles; (2) the inferior division of the third nerve, and its branch to the lenticular ganglion; (3) the inferior set of muscular vessels.

Internally, from within outwards. (1) The superior oblique and internal rectus muscles. (2) The *termination of* the fourth nerve, the nasal nerve, the

ophthalmic artery and vein, and the anterior ethmoidal artery.

Externally, from without inwards :—(1) The lachrymal vessels and nerve, and the lachrymal gland. (2) The external rectus muscle, between the two heads of which pass, both divisions of the third nerve, the nasal of the fifth, the sixth nerve, and the ophthalmic vein. (3) The nasal nerve, lenticular ganglion, and ophthalmic artery.

A *needle passing through the axis of the eyeball* from its anterior surface backwards would traverse successively—(1) the ocular conjunctiva; (2) the four layers of the cornea—viz., anterior elastic lamina, the cornea proper, the posterior elastic lamina, the posterior epithelium; (3) the anterior chamber; (4) the pupil; (5) the anterior layer of the capsule of the lens; (6) the lens; (7) the posterior layer of the capsule of the lens; (8) the anterior portion of the hyaline membrane; (9) the vitreous humour; (10) the posterior portion of the hyaline membrane; (11) the three layers of the retina—viz. (α), Jacob's membrane (rods and cones); (β) the granular layer; (γ) the fibrous layer; (12) the choroid; (13) the sclerotic.

The structures divided in the operation of extirpation of the globe are—the conjunctiva, the sub-conjunctival tissue, the tendons of the recti and obliqui with their aponeurotic sheaths, the optic nerve, and the long and short ciliary vessels and nerves.

The structures divided in the operation for strabismus are the conjunctiva, sub-conjunctival tissue, and rectus tendon with its aponeurotic sheath.

SURGICAL ANATOMY OF THE NASAL REGION.

The structure of the skin of the nose is similar to that in other parts of the body, except that it is very thin and loosely connected with the subjacent parts. The hairs are but rudimentary, and the sebaceous glands *very numerous and* largely developed. These

orifices show themselves as points more or less deep, most abundant on the alæ. Underneath is a layer of cellular tissue very adherent to the skin and subjacent musculo-fibrous tissues which contain a little fat.

The *muscles* of the nose belong to those of expression, and are as follows:—pyramidalis nasi, levator labii superioris et alæ nasi, dilator naris, compressor nasi, compressor narium minor, depressor alæ nasi.

The *arteries* of the nose are derived from the ophthalmic and the facial, the sides and dorsum being supplied by the nasal branch of the ophthalmic and the infra-orbital, the alæ and septum by the superior coronary, and by the lateralis nasi.

The *veins* terminate in the facial and ophthalmic.

The *nerves* are derived from the facial, infra-orbital, infra-trochlear, and a twig from the nasal branch of the ophthalmic of the fifth.

There are numerous *lymphatics*, which empty themselves into the submaxillary glands (lymphatic), and follow the course of the facial vein.

The mucous membrane lining the nostrils is continuous with the skin and that of the nasal fossæ (*vide* "Nasal Fossæ").

The nasal cartilages, forming the softer portion of its framework, are five in number—viz., two upper lateral, two lower lateral, and the cartilage of the septum.

Each upper lateral cartilage is flattened and triangular in shape. Its anterior margin articulates with the cartilage of the septum. The posterior edge articulates with the nasal process of the superior maxillary and nasal bones. The lower edge is connected by fibrous tissue with the lower lateral cartilage.

The alar or lower lateral cartilages are two in number, and completely separate. They are of the form of a horseshoe, with the concavity posterior, and with the external limb longer than the internal. The convexity of these two cartilages is situated in the thickness of the lobe, on each side of the anterior inferior angle of

the cartilage of the septum. The inner limb of this cartilage has its back against that of the opposite side and to the cartilage of the septum in the median line.

There are three or four small cartilaginous plates, situated in the tough membrane connecting the lower lateral (alar) cartilage with the nasal process of the superior maxilla—the *sesamoid*.

The ala of each side is further composed of masses of cellular tissue placed below and behind the alar cartilages.

The bony framework is formed by the nasal bones, to which the external nose owes its form in a great measure; their method of articulation with the frontal and superior maxillary greatly determining its shape and dimensions.

These two oblong bones form, by their junction along the middle line in front, the "bridge" of the nose; they articulate with the *frontal* and *ethmoid*, with the *superior maxilla* and with *each other*.

The great vascularity of the nose and of the adjacent parts renders union after wounds very rapid; indeed, here are cases where the entire organ has been cut off, and been for some little while removed from the body, reuniting entirely after careful adjustment. Plastic operations for the restoration of the nose depend greatly for their success on the surgeon's ingenuity, and also on so fashioning the flaps that they retain the vessels in their continuity, thus providing for their thorough nourishment.

SURGICAL ANATOMY OF THE NASAL FOSSÆ AND SINUSES OF THE NOSE.

The *nasal fossæ* consist of two irregular cavities, for the sense of smell, and also to allow of the passage of air to or from the lung. They communicate with the exterior by means of the nostrils, and with the breathing *apparatus* by means of the pharynx.

The *nostrils* open at right angles to the anterior apertures or nares, and as will be seen from this sketch, the inferior margin of the anterior nares is situated in a lower plane than that of the nostril. The nostril is included in the alar cartilages, having a slight dilatation

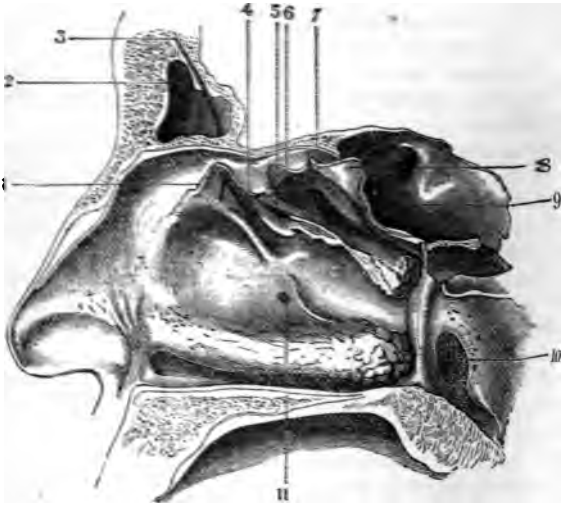


Fig. 8.

1, edge of middle turbinate bone; 2, frontal sinus; 3, sound passed into middle meatus; 4, sinus maxillaries; 5, opening of lower ethmoidal cells; 6 and 8, superior turbinate bone, split and separated; 7, cut edge of middle ditto; 9, sphenoidal sinus; 10, Eustachian tube; 11, occasional opening of sinus maxillaries.

externally and superiorly. The skin is very sensitive, and furnished with strong coarse hairs called *vibrissæ*.

In order to obtain a good idea of the form of the nasal fossæ, vertical and transverse sections should be made, which will not only show the form of these cavities themselves, but also their relations with neighbouring ones.

Each nasal fossa presents for examination a *roof*, *floor*, *internal wall*, *external wall*, *anterior* and *posterior nares* and *mucous membrane*. The vertical diameter of each nasal fossa is greater at the middle of the cavity than at the anterior or posterior parts, and the transverse diameter greater below than above.

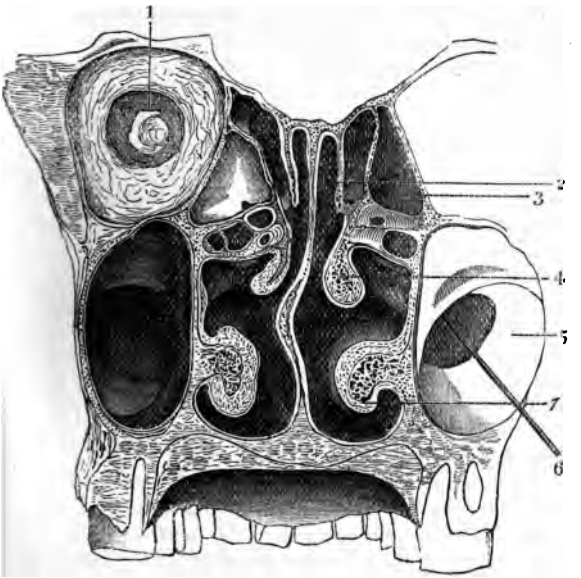


Fig. 9.

1, section of orbit; 2, superior turbinate bone; 3, ethmoidal cells 4, middle turbinate bone; 5, antrum; 6, sound passing into middle meatus; 7, inferior turbinate bone.

The roof is formed by the nasal bones, the nasal spine of the frontal, the cribriform plate of the ethmoid, and the body of the sphenoid. It is to be noted that the entire roof is *not* horizontal, the cribriform plate *only being so, and that it* slopes downwards and

forwards, whilst the sphenoidal portion is in front of th body vertical, and below it horizontal.

The floor is formed by the palate plates of the superio maxillary and palate bones. It is not so long as th superior, it is the widest portion of the fossa, an is concave transversely, and is inclined slightly down wards.

The internal wall or *septum* is formed chiefly by th perpendicular plate of the ethmoid and by the vomer the septal plane is further assisted by the nasal spin of the frontal, the crests of the nasal, superior maxillary and palate bones. (The septum is rendered complet by the triangular cartilage, which projects forward assisting in giving shape and prominence to the nose. It must be borne in mind that this septum is rarel vertical, occasionally it deviates so much from th middle line that inflammation or abscess of its mucou membrane may be mistaken for polypus.

The outer wall is divided into the three meatuses b the projection from it of the three turbinated bone It is formed by the nasal, the superior maxillary, t lateral mass of the ethmoid, and the lachrymal bone posteriorly by the ascending plate of the palate, a the internal pterygoid plate of the sphenoid ; the wa is completed by the lateral cartilages.

Meatuses.—The outer wall of each fossa is subdivid into three (sometimes four) irregular channels, term meatuses—viz., superior, middle, and inferior. T bones entering into the formation of these meatuses a all those of the face, excepting the malar and infer maxilla.

They are divided by the three turbinated bones.

The superior meatus lies beneath the superior spon bone, and is the smallest, and has opening into it t posterior, ethmoidal, and sphenoidal cells. At the ba is the spheno-palatine foramen, communicating w the spheno-maxillary fossa.

The middle meatus lies beneath the middle spon *bone, and has* opening into it in front, the frontal sin

(infundibulum), the anterior ethmoidal cells, and the opening of the antrum, which is almost impossible to find on the living body (*vide* "Superior Maxillary Region").

The inferior meatus, the largest and most important, lies beneath the inferior spongy bone; which extends almost the whole length of the fossa; its lower border, thick and rounded, descends almost to the floor, sometimes converting the meatus into a canal; anteriorly, where it joins the nasal process of the superior maxilla is the orifice of the nasal duct.

The opening into it is the *nasal duct*. This canal extends from the orifice in the meatus to the lachrymal sac, and its orifice is situated about half-an-inch behind the ascending plate of the superior maxilla, and nearly opposite the centre of the under surface of the lower turbinated bone. It is somewhat valvular, owing to the folds of mucous membrane which pass into the aperture, and which are continued up the tube. It takes a direction from *below*, *outwards*, *forwards*, *and upwards* (*vide* p. 23.)

To pass a probe into the nasal duct, the instrument should be first bent into the shape of an italic *f*, which should be passed first along the floor of the fossa, with its concavity towards the entrance; the point is next to be pushed gently beyond the ascending plate of the superior maxilla, and kept in close contact with the outer wall; then it is to be slightly rotated between the fingers, until the point presents upwards and outwards towards the eye; if the handle be now depressed, it should enter the canal.

ORIFICES OF THE NASAL FOSSÆ.

The anterior nares.—The nasal fossæ present for examination four apertures—two anterior and two posterior. The form of the *anterior nares* is somewhat like the heart *of a playing card, inverted*, separated by a septum,

and, as before noticed, the base is at a lower level tha the plane of the nostril; hence, for making an exami nation, the lobe of the nose must be raised as muc as possible. To obtain a complete view of the nasal cavities, it is necessary to detach the integuments from the margins of the anterior nares from within upper

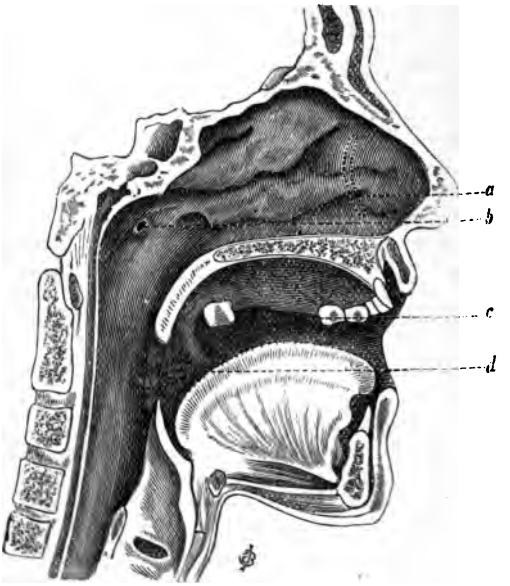


Fig. 10.

a, position of nasal duct; *b*, orifice of Eustachian tube *c*, orifice of Steno's duct; *d*, tonsil between pillars of fauces

lip (Rouge's operation), when, by lifting up the li the floor of the nasal fossæ is readily seen and reache

The *posterior nares* are oval in form, and almo vertical, and are about $\frac{1}{2}$ of an inch, or one inch dee *by about* $\frac{1}{4}$ or $\frac{1}{3}$ wide, separated by the vomer, a

bounded laterally by the internal pterygoid processes. It is important to recollect the form of these apertures, as in cases of plugging the posterior nares, the pledget of lint should correspond in shape, otherwise there is a chance of its being dragged through the meatus, instead of compressing the bleeding vessels against the bone.

The mucous membrane lining the nares completely covers the surfaces of the above-mentioned bony parts, terminating in front at its juncture with the skin. In colour it is red, and its superior surface is studded with orifices of glands which secrete mucus. It is of variable thickness, and is very thin where it is prolonged into the several sinuses. It is thickest on the septum, especially so at its anterior half. It is moderately thick on the roof of the fossa, where it invests the proper bones of the nose and the cribriform plate of the ethmoid; it enters the sphenoidal sinus, and becomes very thin. It lines the anterior ethmoidal cells and the superior spongy bones; it sinks into the groove separating this bone from the sphenoidal sinus, and closes the spheno-palatine canal; and so it may be traced over each portion of the bony and cartilaginous structure to be continuous behind with the pharyngeal membrane and with the skin of the face in front.

Arteries.—This membrane is supplied by the spheno-palatine branch of the internal maxillary, which divides into two branches; the more internal being distributed to the septum, divides and passes towards the anterior palatine foramen; the external is distributed to the external parietes, and subdividing supplies the meatuses and spongy bones.

There are also branches from the superior dental (internal maxillary) to the antrum, from the infra-orbital, and from the pterygo-palatine, and from the ethmoidal (ophthalmic) and facial.

Veins.—The veins form a peculiarly complicated plexus *(rete nasi), which* collect and pass forwards,

terminating in the facial vein; others pass into the frontal vein, and another set pass through the sphenopalatine foramen into the plexus in the zygomatic fossa.

Nerves.—There are two sets of nerves distributed to the mucous membrane of the nose—viz., (*a*) those of special sense; (*β*) those of common sensation.

(*a*) The olfactory, derived from the olfactory lobe, penetrates in three layers the cribriform plate of the ethmoid bone, and is distributed to the ethmoidal and sphenoidal spongy bones, and to the upper part of the septum. (*β*) Those derived from the fifth are the nasal from the ophthalmic division, which passes to the anterior part of the mucous membrane, and leaves the cavity of the nose by passing between the lateral cartilage and the nasal bone (entering by the nasal slit). From Meckel's ganglion are given off the sphenopalatine branch for the septum and the external parietes; the posterior and inferior nasal from the anterior palatine, which is distributed to the posterior inferior portion of the external wall.

There is a point of considerable practical importance with regard to the relation borne by the velum pendulum palati to the posterior nasal apertures. If the mouth be opened there is an involuntary disposition to breathe through it, and thus the palate applies itself closely to the walls of the pharynx, cutting off the communication between the nose and mouth. In syringing out the nostrils, it will be found that if the mouth be open and the nozzle of the instrument be introduced into one of the anterior openings, the current of fluid will wash out the entire nasal cavity and pass out through the other again. In the case of the introduction of the mirror in posterior rhinoscopy the palate must be forced forward by the emission of nasal sounds, or drawn forwards by hooks or forceps constructed for the purpose.

Nasal polypi of the fibro-cellular variety developed in the submucous tissue of this region are covered with *ciliated epithelium*, and are usually attached to the

uperior or middle turbinated bones. The more formidble forms of growths generally project into the fossæ rom the antrum or base of skull. The posterior nares, oval in form and of the same shape as their bony boundaries, enter into the formation of a region termed the *naso-pharyngeal*, situated midway between the nasal fossæ and the pharynx (*vide* "Pharynx.") It is formed also by the body of the sphenoid, the basilar process, and the pterygoid plates.

The basilar process is the usual locale of naso-pharyngeal polypi, and its situation is readily recognized by passing the finger behind the velum pendulum palati, which frequently has to be divided in order to remove such growths.

The orifice of the *Eustachian* tube is a valvular aperture, situated on the inner surface of the internal pterygoid plate, and just above the posterior extremity of the inferior turbinated bone.

To introduce a sound or probe into it the extremity of the instrument should be bent at an angle of about 60°, and passed along the floor of the nostril with the concavity downwards, then pushed backwards by the side of the septum until the mucous membrane of the back of the pharynx is reached; next it is to be slightly withdrawn, and rotated between the fingers, so as to bring its point upwards and outwards, which may be known to be in the orifice of the tube when it cannot be made to rotate easily.

THE SINUSES OF THE NOSE.

The sinuses associated with the nasal cavities are six in number: Two frontal, two sphenoidal, and two uperior maxillary or antra. The latter, from their osition, it has been thought advisable to describe with he superior maxillary region.

The frontal sinuses.—These sinuses are not fully eveloped before puberty; they communicate with the asal *fossæ by the infundibula*, and the mucous mem-

branes are continuous. They are occasionally the se of growths.

The sphenoidal present no surgical interest.

The antrum, unlike the frontal sinuses, exists birth, becomes developed at puberty, and its great expansion is in old age. It is in form like an invert pyramid, the base corresponding with the floor the orbit, and the apex with the alveolar ridge. has four walls—an anterior, an internal, and a poste external, which converge to alveolar ridge, and superior.

The superior, forming the floor of the orbit, is ve thin, and it readily permits of the invasion of growt from one cavity to the other. The anterior wall cor sponds with the canine fossa and the cavity of t bone; readily reached from below the upper lip perforating in the cul-de-sac, formed by the reflexi of the mucous membrane, opposite the first mo tooth.

The postero-external wall corresponds with the m illary tuberosity. The inner wall corresponds with t nasal fossa, and presents two orifices, one constant, t other variable.

Growths within the antrum frequently protru through one or other of these openings into t meatus, and may be mistaken for nasal polypi (*v* "Superior Maxillary Region").

SURGICAL ANATOMY OF THE SUPERIOR MAXILLARY REGION.

This region may be regarded as that occupied by superior maxilla and the tissues covering it. T superior maxilla is a bone of great surgical interest, account of the many diseases to which it is lial hence its position, relations, and connexions are the highest practical importance.

Topography.—The skin and superficial fascia; *lower fibres of* the orbicularis palpebrarum; the fa

and infra-orbital vessels and nerves; the zygomatici and the levator labii superioris; muscles; Steno's duct; the transverse facial artery; the buccal vessels and nerves; lymphatics, and the buccinator muscle. In the hollow between the anterior border of the masseter and the buccinator muscle is a large quantity of fat and cellular tissue, which contributes, either by its excess or deficiency, to the general contour of the face.

Articulations of the superior maxilla.—Articulating with its fellow, it forms the whole of the upper jaw; besides this, it articulates with the frontal, ethmoid, nasal, inferior turbinated, palate, vomer, malar, and lachrymal. The sutures it forms with those bones which enter into the formation of the face are very strong and difficult to separate, so much so, that in excision it will generally be found more satisfactory to divide it or its associate near to the articulation than to attempt to wrench them apart at the sutures. The processes requiring division in its extirpation are the palatine, nasal, and malar. Each bone assists in the formation of three cavities—the mouth, nose, and orbit; of two fossæ, the zygomatic and spheno-maxillary; and of two fissures, the spheno-maxillary and pterygo-maxillary. The relation of these fissures and cavities to the body of the bone is of great importance in the process of its removal. The apex of the antrum corresponds on the face to its malar process, the base of which looks inwards to the outer wall of the nose; and its roof is formed by the orbital plate, and its floor by the alveolar process. The walls of the antrum are very thin, so that growths or collections of fluid readily cause a bulging of its parietes and protrusions into neighbouring cavities or fissures. The fangs of the first and second molar teeth project into its floor, hence the importance of extracting one of these teeth, and perforating its socket before interfering with any doubtful tumour connected with the cavity (*vide* "*Sinuses of Nose*").

Besides the growths which are developed in the antrum, the bone is surgically interesting as being subject to an arrest in its development, known as *fissured or cleft palate*, frequently associated with a similar one in its appendage, the upper lip, termed *hare-lip*. During its development that portion which carries the incisor teeth is a separate segment, and if this segment be disunited the result is a deep fissure, extending backwards into the palate; occasionally these segments in both bones are thus disconnected, in which case they both hang from the end of the vomer, leaving a chasm in the roof of the mouth, a condition usually associated with a double hare-lip.

Structures divided in excision of the upper jawbone. —Supposing the incision through the upper lip, along the ala of the nose, towards the inner angle of the orbit, and along its lower margin, to be adopted; first are the tissues composing the upper lip—viz., the integument, the orbicularis oris muscle, the cellular tissue containing the labial glands, the coronary vessels, facial, and branches of the second division of fifth nerves, and the mucous membrane. Next carrying the incision along the ala and side of the nose, the integument, fascia, levator labii superioris, alæque nasi, with its aponeurosis, the angular vessels and branches of the infra-orbital and facial nerves. The incision along the lower border of the orbit divides the integument, aponeurosis, orbicularis palpebrarum muscle, the vessels of the lower eyelid, and the orbital fascia; and if a portion of the floor of the orbit be removed, the tendon of the inferior oblique, and by turning back the flap enclosed by these incisions, the attachments to the bone of the following muscles—orbicularis, levator labii superioris et alæ nasi, levator labii superioris, compressor naris, depressor labii superioris, levator anguli oris, buccinator, infra-orbital vessels and nerve, and facial vessels and nerves. The *advantage of this* method of external incision is that *the vessels are* divided near their termination, and

not through their larger branches, the duct of the parotid is left entire, without the risk of salivary fistula, and an almost unnoticeable cicatrix is left, by following the natural furrows of the face.

In the second stage of the operation, an incisor tooth being extracted, the gum, alveolar process and structures forming the hard palate—malar and nasal processes, with a portion of the floor of the orbit. In the subsequent dislocation of the bone, the internal maxillary artery, with its vein and the branches after they have gained the pterygo-maxillary fossa; and the posterior palatine nerves are divided.

SURGICAL ANATOMY OF THE REGION OF THE SOFT PALATE AND TONSIL.

The soft palate, which is suspended obliquely from before backwards from the posterior border of the palatine arch, or hard palate, is a curtain consisting of mucous membrane, muscular and fibrous tissue, vessels and nerves, forming an incomplete septum between the nasal and buccal cavities, serving to prevent the food from passing upwards into the nasal fossæ, helping to push it downwards into the pharynx during deglutition, and also influencing the quality of the voice. Its movements are elevation, depression, and transverse tension. It is concave anteriorly, and its inferior anterior border presents two semilunar margins, the edges of which pass downwards to the sides of the tongue, united in a central raphé, from which depends a prolongation, the uvula.

In structure the soft palate consists anteriorly and inferiorly of a mucous membrane, thickly studded with muciparous glands, continuous with that of the posterior region of the mouth; and posteriorly and superiorly of a second membrane, continuous with that of the naso-pharyngeal region. Between these mucous layers is a musculo-tendinous one, *consisting* of portions of the *following pairs of intrinsic* muscles—the levatores

palati and the tensores or circumflexi palati; and of *extrinsic* muscles, the palato-glossi and the palato-pharyngei. Some delicate muscular fibres are to be found in the uvula. The order in which the structures enter into the formation of the velum is as follows:—From before backwards (1) the anterior layer of mucous membrane; (2) the aponeurosis of the tensores palati, with which are blended the attachments of the palato-glossi and palato-pharyngei; (3) the levatores palati, uniting in the median raphé; (4) the posterior layer of mucous membrane.

The pillars of the fauces are formed by the divergence of the palato-glossus and palato-pharyngeus, and include a triangular interval, the base being downwards, in which is situated the tonsil. The posterior pillars formed by the palato-pharyngei are nearer each other than the anterior, formed by the palato-glossi.

The space between the palatine arches of both sides is called the *isthmus of the fauces*, and is bounded above by the free margin of the palate, below by the dorsum of the tongue, and laterally by the pillars of the fauces and tonsils.

A correct knowledge of the attachments and actions of the muscles of the soft palate is of great importance, with a view to the successful performance of operations for the relief of fissures or clefts in it.

The fibres of the levator palati pass downward and inward, spreading out on the velum as a layer, which is embraced by the two planes of fibres of the palato-pharyngeus and unites with its fellow of the opposite side. The tensor palati ends in a tendon, which is reflected horizontally round the hamular process of the sphenoid, and after spreading out is inserted into the aponeurosis of the velum, below the levator palati, and into the palate bone. *The position of the hamular process*, an important guide in the performance of operations, can be felt distinctly in the substance of *the soft palate*, internal to and slightly posterior to the *last molar tooth*.

The action of the palatine muscles upon a fissure isting in the velum would obviously produce a sepaation of its margins, and it has been shown that the uscular action by which these margins are brought gether is caused by the upper semicircular border f the superior constrictor of the pharynx, and that he muscles to be divided in the operation of *staphyoraphy* or stitching up the fissure, are the levatores alati and the palato-pharyngei, the upper expanded asciculi of which are divided into two parts by the evatores palati, and if necessary the palato-glossi. Fergusson.)

The levator palati is to be divided on both sides by utting the undeveloped velum upon the stretch, when a double-edged knife is passed through the soft palate, ust on the inner side of the hamular process, and above the line of the levator palati.

Another method of dividing the levator palati is by assing a knife curved on the flat through the fissure nd behind the flap, its edge making an incision half n inch long, half way between the hamular process nd the orifice of the Eustachian tube, and perpendiular to a line drawn between them.

The *thickness* of the velum pendulum palati must be aken into consideration in this operation; it is often nderrated, and hence difficulty may be experienced in reshening the edges of the cleft.

The palato-pharyngeus is to be divided by cutting hrough the posterior pillars just below the tonsil. Occasionally the palato-glossus requires division.

The tonsils or *amygdalæ* are two small glandular bodies, varying in size in different individuals, situated between the anterior and posterior pillars of the fauces, and covered in by the bucco-pharyngeal fascia. They are in relation, *externally* with the superior constrictor, and by it separated from the internal carotid and ascending pharyngeal vessels; *below* they rest on the side of the base of the tongue. The position of the tonsil *corresponds with* the angle of the inferior

maxilla. Under *certain* circumstances the c artery is in danger of being wounded, such excision of the gland or the evacuation of when by its enlargement it is brought still closely into connexion with the vessels; but precaution be taken of lifting it well from it forwards and inwards before the knife is applie

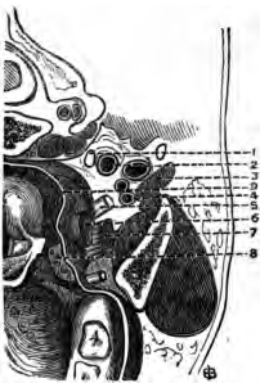


Fig. 11.—Diagram of the relations of the Left Tonsil from above.

1, superior cervical ganglion; 2, internal carotid arter jugular vein; 3, digastric muscle; 4, external carotid a 5, glosso-pharyngeal nerve (drawn too thick); 6, stylo-p geus muscle; 7, stylo-glossus muscle; 8, the tonsil; 9, of the pharynx and its mucous membrane.

its removal, the risk in this instance is avc and in the latter, care must be taken not to the knife outwards in the line of the angle jaw, but backwards into the tumour towards the and so allow it to cut its way out, towards the m line of the body.

There seems to be a great fear of woundin internal carotid in excision of this gland, but a *at its relations* by a section shows that the vesse

t least an inch behind it, and about four lines in front f the internal carotid is the external carotid, diverging utwards into the parotid gland. It is, therefore, mpossible that in dragging out the tonsil, either of hese vessels should also be dragged out or wounded, nd only by using pointed instruments, or unpardonble roughness, could it happen.

The *vessels* of this region are derived from the scending pharyngeal of the external carotid, the ascending palatine and tonsillitic of the facial, the dorsalis linguæ of the lingual, and the descending palatine of the internal maxillary; and the *nerves*, from the glosso-pharyngeal and Meckel's ganglion.

SURGICAL ANATOMY OF THE PAROTID REGION.

The boundaries of the parotid region are somewhat difficult of definition, partly on account of the irregularity of the gland, and partly on account of its belonging both to the cranium and to the neck. The following appear to be the simplest:—*In front*, the posterior border of the ramus of the jaw; *behind*, the mastoid process of the temporal bone, the cartilage of the ear, and the edges of the sterno-mastoid and digastric muscles; *above*, the zygomatic arch; and *below*, an imaginary line drawn horizontally backwards and inwards from the angle of the jaw to the styloid process, by the stylo-hyoid and stylo-maxillary ligaments, and the process of cervical fascia passing from the sterno-mastoid to the jaw. The dimensions of this region obviously vary with the several movements of the lower jaw; moreover, there are certain differences in its size with respect to the age of the individual: thus, in the infant, the region is broader in proportion below, on account of the obliquity of the jaw and the non-development of its angle, and bulges externally, on account of the *quantity of* fat and lymphatics contained *within it; again, in* old age, in the edentulous

state, the base of the region becomes broader, owing the falling forward of the jaw.

Beneath the integument covering the parotid gla it will be seen to be enveloped in an incomplete c sule derived from the cervical fascia, which separate from neighbouring structures.

The relations and connections of the parotid gl are, *externally and superficially*, the lymphatics, platysma myoides, some few branches of the superfi cervical plexus, and the integument; *anteriorly*, posterior border of the ramus of the jaw, the exter and internal pterygoid muscles, between which lie process of the gland; *inferiorly and posteriorly*, mastoid process, the sterno-mastoid, posterior belly digastric, styloid muscles, transverse process of at internal jugular vein, internal carotid artery, eigl pair of nerves, hypoglossal nerve, and the super cervical ganglion of the sympathetic.

The substance of the gland contains so many portant structures that operative proceedings connec with it are rendered excessively difficult and hazardo The external carotid artery traverses its posterior pa giving off its anterior and posterior auricular and sup ficial temporal branches. Behind the external caro is the external jugular vein, which receives numer branches in its substance. A quantity of lymphat are also found in relation with the gland. The sup ficial lymphatic ganglia receive the vessels of the sca those within the gland, the vessels from the eyebro lids, and cheeks; and the deepest, which accompany internal carotid, are the vessels of the temporal a maxillary regions. The facial nerve, after it l passed through the stylo-mastoid foramen, enters t posterior and inferior portion of the parotid, a thence spreads out into several large plexiform branc (*pes anserinus*), after which it ramifies amongst t muscles of the face. The auriculo-temporal branch the inferior maxillary nerve also enters the gland af *having passed* behind the neck of the jaw, and for

inosculations with the facial. The auriculo-parotidean branch of the cervical plexus enters the gland anteriorly and inferiorly, inosculating with the preceding.

The existence of the tough fibrous investment which encloses the gland almost entirely and binds it so tightly in its place, accounts for the intense pain in

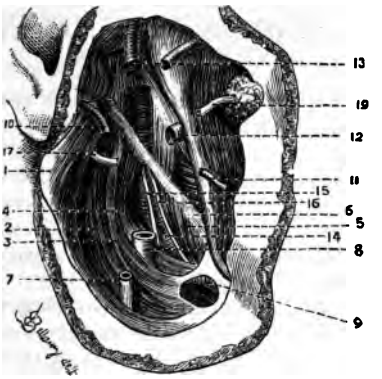


Fig. 12.– Sketch of the deep relations of the right Parotid Gland (the gland itself has been removed and the ramus of the lower jaw drawn forward).

1, remains of aponeurosis of gland; 2, digastric muscle; 3, stylo-hyoid muscle; 4, stylo-pharyngeus (drawn aside); 5, stylo glossus muscle; 6, stylo-maxillary ligament; 7, external jugular vein; 8, external carotid; 9, lingual artery seen through an opening in the aponeurosis; 10, posterior auricular artery; 11, transverse facial artery; 12, internal maxillary artery; 13, anterior and middle temporal arteries; 14, internal carotid; 15, hypoglossal nerve; 16, glosso-pharyngeal nerve; 17, trunk of facial nerve; 19, Steno's duct.

inflammation, as in *parotitis*, or abscess. Wounds, or the results of abscess in the substance of the gland, may give rise to *salivary fistulæ*, which are frequently very troublesome to close; and in the removal of tumours connected with it, or in its neighbourhood, there is, of course, great danger of severe hæmorrhage, and *of wounding the facial* nerve, thus causing

paralysis of the facial muscles. The surgical relations of the duct of the parotid have been already considered (*vide* "Face"). The external carotid may be compressed against the styloid process in the adult, but it is impossible in the child, owing to the undeveloped state of that portion of the bone.

SURGICAL ANATOMY OF THE PTERYGO-MAXILLARY REGION.

The surface markings of this region are the bony prominences of the zygoma and lower jaw, and the contour of the masseter muscle, the tendinous intersections of which are very evident during its action. If the finger be passed into the mouth, the internal aspect of its ramus can be felt; and if the jaws are apart, its coronoid process; the mutual relations of which should be carefully noticed.

Topography.—The integument covering this region is very thick and mobile, and frequently a considerable quantity of fat is developed beneath it, the superficial fascia is very thin and continuous with that in neighbouring regions. The aponeurosis is attached above to the zygoma, below to the edge of the lower jaw, and in front it passes over the buccinator covering in the interspace between it and the masseter; and behind, it passes into the parotid region. Next are met with some branches of the facial nerve and transverse facial artery, the duct of the parotid, and that portion of the parotid which lies upon the masseter. Beneath the masseteric fascia is the masseter itself, which consists of two sets of fibres; the anterior forming the greater bulk of the muscle, and behind and below these some oblique fibres, which are inserted beneath the anterior. The origin of these fibres is on the under and inner surface of the zygomatic arch. It is to be noticed that the anterior surface of the zygoma is entirely subcutaneous. *Beneath the* zygoma the masseteric nerve and vessels *enter the* under aspect of the masseter through the

igmoid notch. The skeleton of the region is the amus, coronoid process, neck and condyle of the nferior maxilla.

Immediately behind the bone is a portion of the nternal maxillary artery, the external pterygoid muscle, and emerging from its lower border the gustatory branch of the third division of the fifth, the mylo-hyoidean branch of the inferior dental nerve, part of the internal pterygoid muscle, the trunk of the inferior dental and deep temporal nerves, the internal lateral ligament of the temporo-maxillary articulation, and in front of the internal pterygoid the posterior portion of the buccinator.

The vessels of this region are, in the *superficial* to the bone—the transverse facial or external maxillary, which arises from the external carotid in the parotid gland, just above the angle of the jaw, and in relation with the portio dura and Steno's duct, crosses the masseter a little below the zygoma.

Beneath the bone the internal maxillary artery commences at the outer border of the neck of the jawbone, lying in the first part of its course behind it, and in front of the internal lateral ligament; it then curves forwards to the lower border of the external pterygoid muscle, lying on it, and, generally disappearing between its two heads, passes into the pterygo-maxillary fossa. The trunk of this vessel or its descending branch, the inferior dental, are usually divided in resection of the bone. Its tortuous course and variable position render it the more liable to be wounded.

The nerves are derived from the inferior maxillary division of the fifth, which passes into the region through the foramen ovale of the sphenoid. The nerve consists of two portions—a muscular, distributed to all the muscles of mastication—viz., masseteric, deep temporal, pterygoid, buccal; and a sensory—the inferior dental, auriculo-temporal, and gustatory. The relations of the *salivary glands* to the body of the *inferior maxilla are of* considerable importance with

regard to operations on it. The parotid envelopes the posterior border of its ramus, and passes behind its neck as far as the styloid process of the temporal bone; the submaxillary gland is partially lodged in a fossa, below the attachment of the mylo-hyoid, which during flexion of the head is concealed beneath, and in extension is considerably disengaged from the bone—facts to be considered in operations in the region of the upper part of the neck.

The temporo-maxillary articulation is formed between the glenoid cavity of the temporal bone and the condyle of the lower jaw. Interposed between the bones is a biconcave interarticular fibro-cartilage, above and below which is a synovial sac. The external portion of the circumference of this cartilage is connected with the external lateral ligament, whilst a portion of the tendon of the external pterygoid muscle is inserted into it in front controlling its movements. *The ligaments* are the external lateral, attached to the tubercle on the zygoma and to the external surface of its neck, which is covered over by the parotid gland; and the internal lateral, attached to the spine of the sphenoid and to the inner margin of the dental foramen. The external pterygoid muscle is in relation with this ligament above, the internal maxillary artery lies between it and the neck of the jawbone, and between its insertion and the ramus of the jaw are the inferior dental vessels and nerve; and on its inner side is the internal pterygoid muscle. The stylo-maxillary ligament, really a slip of the deep cervical fascia, is attached to the styloid process of the temporal bone and to the inferior angle of the lower jaw; it separates the parotid from the submaxillary gland, and gives origin to some fibres of the stylo-glossus muscle.

Owing to the numerous movements which the muscles of mastication are capable of causing, and to the comparative laxity of the ligaments of the articulation, the *lower jawbone* is liable to partial or complete dislocation

tion. The condyles glide forward, carrying the inter-articular fibro-cartilages with them, upon the eminentiæ articulares, in such conditions as yawning or laughing, or masticating large morsels; the combined action of the masseter and internal pterygoid muscles drags them under the zygomatic arches, whilst the temporal muscles drag the displaced bone upwards. The obstacle to reduction appears to be, that in most cases the coronoid process is, as it were, locked in front of the malar tubercle. Partial luxation of one condyle is of common occurrence, and occasionally a portion of that process of the parotid which wraps round the neck of the jaw is included between the opposing surfaces, causing severe pain and inconvenience. The principle upon which reduction is effected is by introducing some solid body between the molar teeth so as to form a fulcrum, whilst the power is applied at the symphysis, at the same time that the angles are depressed.

SURGICAL ANATOMY OF THE LINGUAL REGION.

By the lingual region is meant all the inferior wall of the buccal cavity.

The tongue completely occupies the cavity of this when the mouth is shut, and is attached for the posterior two-thirds of its volume to the hyoid bone and inferior maxillary bone, by its extrinsic muscles and membranes; by means of the stylo-glossus it is attached to the styloid process, and by the palato-glossus to the palatine arch. It is at this portion of the organ that the nerves and arteries enter and its veins leave it. Beneath it, in the middle line, is a fold of mucous membrane, the frænum, on either side of which are the orifices of Wharton's ducts; and those of the sublingual glands, or ducts of Riviniani, lie in the fossa between the tongue and maxillary bone.

Structure.—The *mucous membrane* is very adherent to *the underlying structure*, particularly on the dorsum

and sides; on the under surface, however, it is less so, there being a cellular layer between it and the sublingual muscles. The mucous membrane is freely supplied with papillæ; the sides and tip with fungiform, almost its entire surface with filiform, and the posterior part of its dorsum with the V-shaped series of the circumvallate. There are a considerable number of glands lying in this tissue, which give rise to the development of that encysted tumour known as *ranula*. An enlargement of the bursa existing between the hyoid attachment of the genio-hyo-glossi, by its enlargement and protrusion beneath the tongue, may be mistaken for ranula.

The *muscles* are both intrinsic and extrinsic. The intrinsic or linguales are two symmetrical bundles of muscular fibre, separated from each other by a fibrous septum, occasionally cartilaginous, and these muscular fibres are arranged into—(1) the lingualis superior, the fibres of which are disposed obliquely and longitudinally on the surface of the organ; (2) an inferior longitudinal set, passing from the hyoid bone to the apex, and in relation on its under surface with the ranine artery; its fibres are blended with those of the stylo-glossus; (3) a transverse set, forming the bulk of the tongue, placed between the superficial and longitudinal, are attached to the fibrous septum, and curving outwards are inserted into the dorsum linguæ and its margin. The fibres interlace with the before-named sets. The existence of the fibrous septum explains how it is that in acute inflammation of the tongue, or when abscess has formed, the tumour is frequently unilateral.

The extrinsic muscles are—the hyo-glossus, genio-hyo-glossus, stylo-glossus, palato-glossus, and some few fibres of the superior constrictor.

Arteries.—The lingual artery at the anterior edge of the hyo-glossi muscles divides into the sublingual and ranine; of these the ranine is the most important: it *lies on the* under surface of the tongue, external to the

genio-hyo-glossi, and on the inner side of the hyo-glossi, stylo-glossi, and sublingual gland. It enters the organ at its base, and runs forwards towards the tip, and in the mouth it lies to the side of the frænum, and is here covered only by mucous membrane; thus, in dividing this membrane for *tongue-tie*, the scissors should be directed *downwards* and *backwards*.

The ranine artery is generally accompanied by *two* ranine veins, which terminate in the internal and external jugular and the facial veins (*vide* "Lingual Artery").

The nerves are very numerous, and are derived from —(1) the hypo-glossal or ninth, which is supplied to the extrinsic muscles only—it is the *motor* nerve of the tongue; (2) the gustatory branch of the inferior maxillary division of the fifth, supplies the sides and tip—a nerve of *special sense:* these two nerves freely anastomose; (3) the glosso-pharyngeal, which supplies the circumvallate papillæ at its base—also a nerve of *special* sensation; (4) the facial, supplying the linguales, by means of the chorda tympani; (5) the vagus, sending a few filaments to its base; and (6) the sympathetic—the *vaso-motor* nerve, accompanying the lingual artery.

The base of the tongue is in relation with the epiglottis, which curves forwards towards it during respiration; but during deglutition it is drawn backwards and downwards, thus covering the aperture of the larynx and preventing food from passing into it (*vide* 'Larynx").

SURGICAL ANATOMY OF THE PHARYNX.

The pharynx is a musculo-membranous tube, lying deeply behind the mouth and nasal fossæ, communicating superiorly with these two cavities, and the internal carotid, whilst below it is continuous with the larynx and œsophagus. The length of the pharynx varies *from about 5¼ inches* to 6½ inches. It extends

from the basilar process to the space between the and 6th cervical vertebræ, when the pharynx is rest, but the contraction of its muscular struct gives rise to considerable variations in this resp It is somewhat distended at its centre, and tigh contracted at the point where the œsophagus c mences.

The breadth of the pharynx, at level of the isthm of the fauces, is about from 1½ inches to 2 inch whereas at the level of the cricoid cartilage it is rat less than ½-inch; hence foreign bodies are liable to arrested at this point, and may by pressure on th superior orifice of larynx cause instant death.

The pharynx presents for examination four walls an anterior, which is only partial, since it correspon ds with the openings into neighbouring regions, a posterior, and two lateral.

The *anterior* contains from above downwards the posterior nares, the velum pendulum palati, the posterior pillars of the fauces, base of tongue, epiglottis, the glosso-epiglottic folds, and larynx.

The *posterior* wall is in relation with the cervical vertebræ, being separated from them by the recti antici and longi colli muscles.

The *lateral* walls, also formed by the constrictors, are in relation with the sympathetic, glosso-pharyngeal, spinal accessory, vagus, and hypo-glossal nerves, internal carotid artery, and internal jugular vein. In front of the vessels and nerves, the pterygo-maxillary region, pterygoid plates of the sphenoid, deep portion of the parotid, and the lateral portion of the submaxillary region are in immediate relation with them. This close relation to the parotid and internal maxillary regions, explains the pointing of abscesses forming in these spaces at the sides of the pharynx.

For surgical examination the pharynx naturally divides itself into a nasal, a buccal, and a laryngeal portion.

The nasal is limited above by the basilar process,

which is very much inclined in a direction oblique from before backwards, below by a plane passing through the palate, and which would impinge on the ring of the atlas, and laterally by the pterygoid plates. The inferior aspect of the basilar process is covered

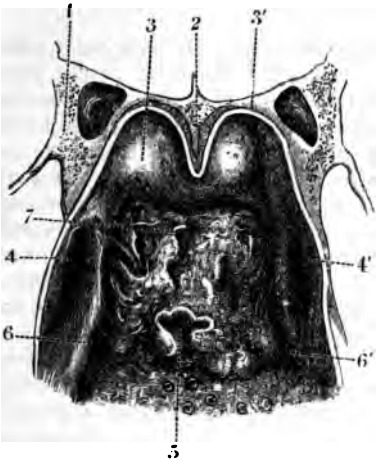


Fig. 13.—Roof and Posterior Wall of Pharynx.

1, sphenoid; 2, vomer; 3, posterior end of nasal fossa; 3, cut edge of mucous membrane; 4, 4', opening of Eustachian tube; 5, opening of bursa pharyngea; 6, 6', recessus pharyngeus; 7, adenoid tissue of pharynx.

with a dense fibrous membrane, which is a frequent seat of origin of naso-pharyngeal polypi. Its dimensions are about 1 inch to 1½ inches deep, by 1½ inches wide.

The *buccal* portion lies between the above-mentioned plane and the base of tongue and epiglottis below and on either side the lateral walls of the pharynx. This portion corresponds to the vertebral column, and by introducing the finger through the mouth the body of the axis and anterior tubercle of the artery can be

felt superiorly, and the upper borders of the 4th cervic vertebræ below. Its dimensions are from 1½ inches 2 inches in breadth to about 2½ inches in depth.

The *laryngeal* portion extends from the base of tl tongue to the lower border of the cricoid cartilage, a is about 2½ inches to 3 inches long and about ½-in wide.

Structure of pharynx.—By making a plane secti through the tube, the following tissues would be i cluded, from before backwards:—A mucous layer, glandular layer, a fibrous layer (pharyngeal aponeurosi a muscular layer, and a fibro-cellular layer. Betwe the fibro-cellular coat of the pharynx is a quantity loose cellular tissue, in which *retro-pharyngeal* abscess form, frequently from disease of the cervical vertebr These abscesses push the pharynx forward against tl posterior nares if high up, and if lower down, by pres ing upon the larynx interfere with respiration a speech. They can be readily detected by examini the posterior wall or by palpation. Occasionally the abscesses point at the side of the neck in front of tl sterno-cleido-mastoid (*vide* "Fasciæ of Neck").

CHAPTER II.

SURGICAL ANATOMY OF THE NECK.

HE region of the neck may be described as that rtion of the body which is contained between the cipital bone, mastoid processes, and lower jaw above, d the superior aperture of the thorax below—mely, the first two ribs, laterally; the manubrium rni, anteriorly; and the first dorsal vertebra, posriorly; and for the sake of simplicity will be vided as follows:

An *anterior*, including the submaxillary or supraoid region, and the infra-hyoid, or tracheal region; a *teral*, the sterno-mastoid or carotid, the supra-clavilar, the occipital; and a *posterior*, including the ape of the neck—a method which seems advisable being a natural one, and agreeable to its external nformation.

Surface markings.—The development of the neck aries in individuals, both with regard to age and to x: round and smooth in females and children; muslar, and with all its prominences well marked, in lult males.

As far as its normal length is concerned, in adults is tolerably constant, the difference in certain pers being rather apparent than real, resulting from ne peculiarity in the conformation of the shoulders, Its breadth is variable.

The points of chief interest to the surgeon are those ncerning the hyoid and laryngeal apparatus and sterno-cleido mastoids, and the hollows between l behind these muscles. The first prominence ow *the chin is the pomum* Adami, which is far

more marked in males than in females, and becomes developed at puberty; nearly a finger's breadth above this can be felt the hyoid bone, with the anterior belly of the digastric muscle sweeping upwards towards the chin. Immediately below the thyroid cartilages, in the median line, is a depression, indicating the position of the crico-thyroid membrane; next, the body of the cricoid cartilage itself; below this, the upper rings of the trachea may be distinguished, and at about the third ring the isthmus of the thyroid body can generally be made out, more particularly in women. The position of the laryngeal apparatus during swallowing should be noticed, as it is drawn upwards at the commencement of the act, returning to its normal position on its completion, the thyroid body being carried with it. This fact is of great value in the diagnosis of tumours in the region of the trachea or carotid vessels. In children the trachea is more deeply placed, very small and moveable (*vide* "Trachea").

The anterior and posterior borders of the *sterno-cleido-mastoidei* are very evident, even when these muscles are at rest, from the prominent mastoid processes to their inferior attachments—the sternal of which is fusiform and cordlike, and the clavicular, flat and ribbon-shaped, lying posterior to the former, and variable in its extent along the clavicle. The point of divergence of these two sets of fibres is generally well seen, more especially, however, when the muscle is in action, as in rotation of the head from side to side. These points will be hereafter seen to be important landmarks to the surgeon in the operative surgery of the neck. Between the angle of the jaw and the mesial line is the protrusion of the submaxillary gland, the difference in the position of which during flexion or extension of the neck should be carefully noted. Above the clavicle, and between the prominences of the sterno-cleido-mastoid and trapezius, *is a hollow*, the *supra-clavicular fossa*, at the lower *and internal* part of which the posterior belly of the

no-hyoid crops up from behind the clavicle. This uscle lies much more hidden by the sterno-cleido-astoid and clavicle than is usually represented in plates the posterior triangle. It is seen in action after allowing, during the depression of the hyoid bone, nd during deep inspiration. The subclavian artery eats at the bottom of this hollow, and is here readily mpressed against the first rib (*vide* "Surgical Anatomy f Subclavian Triangle"). The lateral contour of the eck is completed, behind, by the sweep of the trape-ius from the occiput to the tip of the shoulder. Pos-eriorly the neck presents a median depression, on ither side of which is seen the mass of the extensor nuscles of the head, and lower down the spinous pro-esses of the sixth, seventh, and eighth (*Vertebra rominens*) cervical and first dorsal vertebræ. The xternal jugular veins are seen on the lateral aspect f the neck, crossing the sterno-mastoid obliquely, rom before backwards, at about its middle, and assing into the hollow behind it. The more etailed account of these superficial markings will e found in the description of the several regions f the neck.

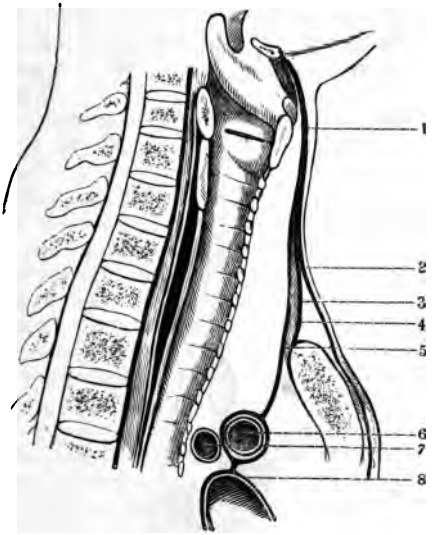
*Arrangement of the cervical fascia.**—The attach-ments and connexion of the fasciæ of the neck are of reat surgical importance, inasmuch as these aponeu-otic sheaths in a great measure control the course aken by diffuse inflammation, collections of pus, lood, and growths; the latter frequently not appear-ng externally in the neck until some while after hey have extended or sent processes along or amongst hem.

For convenience of examination and simplicity of lescription it may be divided into two layers—a super-ficial and a deep, and these laminæ and the spaces they enclose may be studied by horizontal and vertical

* It has been thought advisable to introduce the description of the cervical fascia *here, as a correct idea* of it will facilitate that of *the several regions of the neck.*

sections. First, by horizontal section. The *superficial* layer is usually traced from behind, where it commences as a very thin lamina attached to the spinous processes of the cervical vertebræ, superior curved line of the occipital bone, and ligamentum nuchæ; and passing forwards, getting denser as it proceeds, it encloses the trapezius, and, forming sheaths for the posterior muscles of the neck, extends over the posterior triangular space, and arriving at the posterior border of the sterno-cleido-mastoid, forms a sheath for it; and part of it, which constitutes the anterior portion of this sheath, is attached to the lower border of the body and angle of the lower jaw and zygoma after having covered in anteriorly the parotid gland and masseter muscle; below it is attached to the anterior part of the clavicle and manubrium sterni, and is perforated by the external jugular vein and cutaneous nerves. The *deeper layer* has an attachment to the tubercles of the transverse processes of the cervical vertebræ, and encloses the scaleni muscles, forming the prevertebral aponeurosis, which sends processes over the cords of the cervical and brachial plexuses and subclavian vessels. The lax cellular tissue lying between the prevertebral aponeurosis and the pharyngeal muscles is the seat of retro-pharyngeal abscesses, which point either into the pharynx or, guided by fascia, behind the carotid vessels (*vide* "Pharynx"). Passing from the under surface of the sterno-mastoid towards the middle line, it is attached to the hyoid bone, forming an aponeurotic loop on its upper surface, through which runs the tendon of the digastric; and extending downwards it forms the sheaths of the sterno-hyoid and sterno-thyroid muscles. The lamina forming the posterior portion of the sheath of the sterno-mastoid is attached above to the angle of the jaw and to the base of the styloid process behind, and to the inner side of the parotid gland, forming a septum between it and *the submaxillary* gland, the *stylo-maxillary ligament.*

lower portion of this lamina forms the sheath of carotid vessels, which sheath is divided by septa osing internally the carotid artery, externally the rnal jugular vein, and posteriorly the vagus nerve; ed downwards and outwards it is found to enclose omo-hyoid muscle, binding it down to the clavicle, l enclosing the subclavius muscle, passes beneath it



14.—Diagram of an Antero-posterior Section of the Infra-hyoid Region in the median plane.

superficial lamina of superficial fascia; 3, middle lamina; reduplication of this lamina passing behind the sterno-yroid, and enclosing the left innominate vein, and coming continuous with the pericardium; 5, space occupied sterno-hyoid; 6, left innominate vein; 7, innominata; 8, icardium.

the axilla, to be continuous with its fasciæ (*vide* illa"). At the root of the neck this fascia is easily nstrated *to be continuous* with the pericardium.

If the arrangement of the cervical fasciæ be st a vertical section, it may be seen that the three differ in their arrangement according as this falls on the sternum or on the clavicle, if in th line (Fig. 14) the anterior passes in front of tl bone, and terminates in the anterior aspect sternum. The middle lamina, after ensheatl sterno-hyoid and thyroid, at their sternal

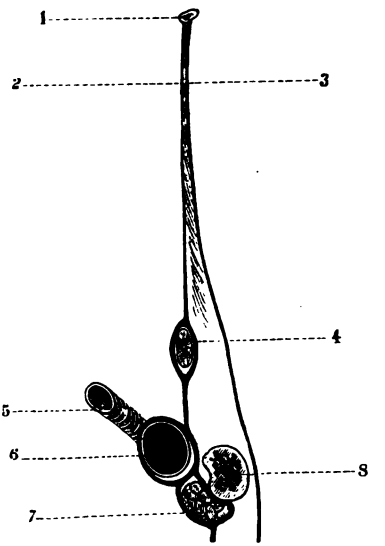


Fig. 15.—Diagram of a Section of the Infra-hyoid passing through the middle of the Clavicle.
1, hyoid bone; 2, middle lamina of cervical fascia; 3, lamina of cervical fascia; 4, omo-hyoid; 5, subclav 6, subclavian vein; 7, subclavius muscle; 8, clavicle.

ments, divides into two layers, an anterior in the sterno-hyoid, and firmly attached to the *and the* posterior, which lies behind the sterno

ınd, after enclosing the left brachio-cephalic vein, is ontinuous with the pericardium. If the section passes n one side of the mesial line (Fig. 15), so as to fall on he clavicle, the anterior lamina is the same as before, he middle one furnishes a sheath to the omo-hyoid, and ecomes attached to the posterior border of this bone, ınd, after enclosing the subclavius muscle, passes on to orm the suspensory ligament of the axilla, the middle amina of the subdivision encloses the subclavian vein; vhilst the posterior covers over the subclavian artery, he nerves of the brachial plexus, and the transverse rocesses.

That portion of the fascia which is attached to the yoid bone above and to the clavicle and sternum elow, has been supposed to have some influence on espiration, enclosing in its reflexions the depressors f the hyoid bone, and sending processes around the reat venous trunks. The omo-hyoidei, in particular, y their contraction tighten it, and when tense, the ılibre of the veins is increased, and as these mus-es only contract during *inspiration*, the dilatation the veins coincides with the dilatation of the thorax, ereby urging the blood towards the heart. This, oreover, explains how readily air may pass into the ght side of the heart should any one of the larger ins or some branch close to the trunk be divided.

These several layers of fascia are attached both to ıe margins of the superior aperture of the thorax ıd to those structures which pass upwards or down-ards through it; and as they are connected together y transverse septa, they constitute a species of dia-hragm between the cervical and thoracic regions.

Cervical abscess.—An examination of the cervical ascia shows that there are distinct cellular spaces onfined by them, which may be the seat of abscess.

1. *The capsule of the submaxillary gland.*

2. *The prævisceral space.*—This lies in front of the arynx, thyroid gland, and trachea, and behind the ongue *muscles, passing* upwards from the sternum.

By far the greater number of abscesses in this space commence in the gland or in the cellular tissue surrounding it. They press on the trachea, and may pass into the anterior mediastinum.

3.—*The perivascular space.*—The cellular space in which lie the great vessels, and which is in direct communication with the thorax. Abscesses are very liable to form here, on account of the great number of lymphatic glands. They follow the course of the vessels, or they may point at the side of the trachea, at the lower third of the sterno-mastoid, rarely at the posterior border, or they may pass into the anterior mediastinum.

4. *The space beneath the lower portion of the sterno-mastoid.*—The omo-hyoid, with its investing fascia, bounds the upper border of this space, and posteriorly are the scaleni and the great nerves; and hence below is a free communication by means of the subclavian vessels and nerves with the apex of the axilla.

5. *The retropharyngeal or retrovisceral space.*—This lies behind the pharynx and œsophagus, and abscesses developed therein may point laterally in the region of the vessels, anteriorly into the pharynx, or they may extend downwards into the posterior mediastinum.

6. *Prævertebral abscesses.*—Those associated with disease of the cervical vertebræ are bound down by the lamina of fascia covering in the prævertebral muscles, and may either burst through it, or, guided by the nerves of the cervical and brachial plexus, pass downwards into the axilla.

SURGICAL ANATOMY OF THE SUBMAXILLARY REGION.

This region is bounded *above* by the body of the lower jaw, and the floor of the mouth; *below*, by the *hyoid* bone; *externally*, by the anterior margin of the

mo-cleido mastoid muscle. Its surface markings 're been already described.

Topography.—Immediately beneath the integument he subcutaneous cellular tissue, and the fibres of the tysma myoides muscle passing obliquely from the jaw 'ards the chest and shoulder. The anterior border of s muscle is free, and separated from its fellow by a ular interval. Beneath this muscle is a very lax ular tissue, in which ramify the nerves supplying it, ived from the facial and upper cervical. A portion the superior layer of the deep cervical fascia is next t with, attached along the jaw covering in the sub-xillary gland, and forming the anterior portion of capsule; it is continuous externally with the sheath the sterno-cleido-mastoid, and with the fascia covering parotid anteriorly. A great many lymphatic glands either upon or beneath the capsule of this gland, and en enlarged can be readily felt beneath the integu-nt. Beneath this aponeurosis, and enclosed by that tion of it which is attached to the cornu of the hyoid ie, are the submaxillary gland, the stylo-hyoid and astric muscles. The fibres of the stylo-hyoid enclose tendon of the digastric before they are inserted into hyoid bone, just before that muscle passes through loop derived from the deep cervical fascia. The scular fibres of the posterior belly of the digastric superior to those of the stylo-hyoid, and after being ected from the hyoid bone, spread out into a large scular mass, having many tendinous intersections (fre-ntly interlacing with those of the opposite muscle), be inserted into the digastric fossa of the inferior dilla. Lying in the interval between the two bellies the digastric, and overlapped by its posterior belly l by the body of the jaw, is the *submaxillary gland*, losed in its capsule, the posterior portion of which ontinuous with the stylo-maxillary ligament, which arates it from the parotid gland, and superior to it he facial artery *and vein; the* submental branches *these vessels, with the* nerve to the anterior belly of

the digastric, pass forwards towards the symphysis under cover of the body of the jaw. The bulk of the gland being pulled upwards from the fossa in which it is lodged, it will be observed that a portion of it passes beneath the mylo-hyoid muscle, upon which the greater part of it rests.

The structures which lie beneath the mylo-hyoid muscle are, from before backwards, the genio-hyoid; and deeper down the genio-hyo-glossus, along the outer side of which lie the ranine vessels, and external to it the deep portion of the submaxillary and the sublingual glands, and the mucous lining of the floor of the mouth; the hyo-glossus muscle, extending from the cornu of the hyoid bone to the side of the tongue, and upon this muscle from below upwards the ninth or hypo-glossal nerve, Wharton's duct, the gustatory nerve with the submaxillary ganglion and chorda tympani, and the inosculating branches of these two nerves. Upon the cornu of the hyoid bone is seen the trunk of the lingual artery just before it disappears behind the hyo-glossus muscle.

Arteries.—The *facial* artery in this region passes beneath the posterior belly of the digastric and stylo-hyoid muscles and the submaxillary gland, and after giving off branches to the gland, and the submental, it becomes subcutaneous, about an inch in front of the angle of the jaw.

The *lingual* artery is deeper in its course and distribution, and is directed towards the hyo-glossus, and is at first covered by the skin, platysma, and fascia, and rests on the middle constrictor; after passing over the cornu of the hyoid bone, it is crossed by the ninth nerve, the digastric and stylo-hyoid muscles forming an arch over it. It is next covered by the hyo-glossus, and lies on the superior constrictor and genio-hyo-glossus muscles.

The *branches* given off from it are—the hyoid, which runs along the upper border of the hyoid bone; the *dorsalis linguæ*, supplying the dorsum of the tongue

the tonsil, and soft palate; the sublingual, supplying its substance, and the ranine.

Ligature of lingual artery.—To place a ligature upon the lingual artery, that portion of its course where it lies upon the great cornu of the hyoid bone is selected, immediately before it passes behind the outer border of the hyo-glossus muscle, as it is there most accessible; and to reach it, a slightly curved incision is to be made about a finger's breadth below the body of the jaw through the integument and aponeurosis, and the submaxillary gland is to be lifted upwards. After the posterior portion of the capsule of this gland has been divided, the combined lingual and facial veins may be seen passing obliquely forwards, and deeper, the hypo-glossal nerve; at the angle where this nerve meets the tendon of the digastric, lies the artery, taking a curve downwards towards the hyoid bone. Occasionally the vessel pierces the hyo-glossus muscle, this muscle may extend farther back than usual, in which case its fibres must be divided transversely. On the dead body the vessel appears to be tolerably near the surface, but during life the fascia and integuments are so on the stretch and so attached to the salient parts of the region, that when the vessel is exposed, it is actually very deep. The operation is a difficult one, the vessel being only supported by the loose wall of the pharynx, which runs considerable danger of being wounded, so that the only sure firm guide to it is the posterior cornu of the hyoid bone. The hyoid bone may be with advantage drawn forwards into the wound and steadied with a hook.

Veins.—There is often a considerable plexus of veins in this region, the most important being the facial and the lingual; the facial leaves its artery and passes upon the fascia in front of the submaxillary gland, whilst the lingual vein is separated from its artery by the hyo-glossus muscle. Very often these veins form a common trunk, lying superficial to the hypo-glossal nerve, *before entering the* jugular vein.

Nerves.—The superficial nerves have been already referred to; the hypo-glossal enters the region superficial to the external carotid and below the stylo-hyoid and digastric muscles, and passes upwards over the cornu of the hyoid bone between the gland and the hyo-glossus muscles, covered in by the mylo-hyoid; it loops with the gustatory and is seen distributed to the extrinsic muscles of the tongue. The gustatory nerve, with the chorda tympani, lies beneath the gland and passes to the mucous membrane of the sides and tip of the tongue, upon its deeper portion.

The above relations are those borne by the different structures in this region when the head is in its natural position, but when the parts are the seat of operation, and the head thrown back, the contents of the space are put on the stretch; by so doing the position of the submaxillary gland and the facial vessels are considerably altered, as the cavity which naturally exists between the lower jaw and the mylo-hyoid muscle becomes flattened, causing a protrusion of the structures between them. As there are no vessels or nerves of importance in the mesial line of this region, advantage is taken of this to attack cancerous tumours of the tongue from below the jaw, in the operations of Regnoli, etc.

SURGICAL ANATOMY OF THE INFRA-HYOID OR LARYNGO-TRACHEAL REGION.

The *boundaries* of this region are—*above*, the hyoid bone and the base of the tongue; *laterally*, the sterno-mastoid muscles; *below*, the upper border of the manubrium sterni, or inter-clavicular notch; *posteriorly*, the cervical vertebræ, covered by the longi colli muscles and deep fascia.

This region is surgically important as containing the larynx and trachea, the cervical portion of œsophagus and the thyroid body, with their respective vessels and *nerves.*

ography.—Beneath the integument is the sub-
ous cellular tissue, and the anterior portion of
atysma, which is usually unconnected with its
of the opposite side, there being a cellular
ıl between them formed by the fascia super-
, which joins its fellow lamina of the opposite
the mesial line, well marked in the necks of old
when the fat is absorbed, causing the "dew-lap"
ance characteristic of age. In this superficial
is the anterior jugular vein, or mediana colli, and
is subject to considerable variation. Beneath the
na and its envelope is a thin layer of cellular
which allows of the free movements of the
ment and platysma over the underlying apo-
is. This layer of the cervical fascia from the
f one sterno-cleido mastoid to the other consists
one lamina, including the sterno-hyoid muscle
portion of the omo-hyoid. In the supra-sternal
e, there is a lamina extending between the sterno-
d and the manubrium sterni, and which, about
ı and a half above the bone, blends with the
of the sterno-hyoid, enclosing some lax cellular
in which is a plexus of veins associated with the
r jugulars. The sterno-hyoid and omo-hyoid
s themselves form the next layer, in their apo-
ic sheaths, and immediately below them lie the
thyroid and thyro-hyoid muscles. The sterno-
muscles pass somewhat obliquely, so that the
ace between their internal free borders is rather
towards the sternum than at the hyoid bone;
the inner margins of the sterno-thyroids are
r oblique in the opposite direction. The nerves
ing these muscles are seen generally on their
or borders, or ramifying upon them.

w the sterno-hyoid and thyro-hyoid lie the crico-
l muscles between the thyroid and cricoid
ges. This completes the muscular layer.
orly between the thyroid cartilage and the hyoid
s *the thyro-hyoid* membrane, and behind this

structure is the mucous membrane, extending from the root of the tongue to the pharynx, and thus common to the bucco-laryngeal cavity. The lobes of the thyroid body are connected by means of the isthmus, which lies usually over the second or third rings of the trachea, and occasionally a so-called suspensory ligament passes from it to the hyoid bone. Below the isthmus is a plexus of veins; the interior and middle thyroid passing downwards within the thyroid body, and the thyroidea ima artery, when it is present. Surrounding the trachea itself is a zone of lax cellular tissue, allowing of its free movement. Laterally the tracheal apparatus is in relation with the sterno-hyoid and sterno-thyroid muscles, and the lobes of the thyroid body, which separate it from the great vessels and vagi nerves, and with the superior and inferior thyroid arteries, a plexus of veins, and the recurrent laryngeal nerves. On the right side of the neck, the common carotid artery crosses the lower portion of the trachea obliquely, but subsequently lies parallel to it on the left side the common carotid is deeper than on the right and lies along the trachea. It must be borne in mind that neither of these vessels is in *actual* contact with the trachea. Behind the trachea is the œsophagus, which commences opposite the fifth cervical vertebra and cricoid cartilage, and passes to its left side—a circumstance which is taken advantage of in the performance of the operation of œsophagotomy. The recurrent laryngeal nerve lies in the interspace between the borders of the trachea and œsophagus, and passes below the inferior constrictor and into the larynx through the crico-thyroid membrane.

For convenience of reference, in this region two triangular spaces, termed by Velpeau the *omo-hyoid* and the *omo-tracheal*, may be noted; the former bounded by the hyoid bone above, sterno-mastoid externally, and the omo-hyoid internally, contains the superior thyroid artery, superior laryngeal nerve, *portion of the* middle and inferior constrictors, alæ

roid cartilage, and thyro-hyoid membrane; the latter bounded above and externally by the omo-hyoid, w and externally by the sterno-mastoid, and inally by the middle line of the neck, and contains sterno-hyoid and thyroid muscles, a lobe of the roid body, the superior and inferior thyroid arteries, descendens and communicans noni nerves, sides of id cartilage and trachea, the recurrent laryngeal es, and, on the left side, the œsophagus.

essels.—*The superior thyroid artery* arises from the rnal carotid artery, below the greater cornu of hyoid bone, and at first lies superficially, in a space nded by the sterno-mastoid, digastric, and omo-id muscles. It then passes upwards and inwards, arches down to the upper part of the lobe of the roid body, lying below the omo-hyoid, sterno-hyoid, sterno-thyroid muscles, having behind it the rior laryngeal nerve. Its crico-thyroid branch runs sversely across the crico-thyroid membrane, and be wounded in laryngotomy.

he inferior thyroid artery, in this region, passes quely upwards and inwards, crossing behind the mon carotid artery, internal jugular vein, pneumo-ric, and sympathetic nerves; and on the left side it in front of the œsophagus and behind the thoracic , and enters the lower part of the lobe of the roid body. These and the superior and posterior els very freely anastomose with each other, and a those on the opposite side.

eins.—The *superficial* veins are generally two small llel ones having a loop between them, and terminat-in the supra-sternal fossette, and having communi-ng branches on either side with the subclavian s. They are subject to several anomalies. No fear danger need be felt at dividing them during an ration. The *deep* veins are those coming from the er border of the thyroid body, the middle and inferior roid veins. They form a plexus, and terminate in *left innominate vein.*

Non-surgical wounds, whether suicidal or otherwise are invariably made *across*, and, as a rule, the main vascular trunks escape, unless the attempt be very determined, for the head is thrown back and these main trunks recede, when the sterno-mastoid is put on the stretch. The usual situation selected for such attempts is the thyro-hyoid space, and the incisions frequently divide the larynx and some branches of the superior thyroid artery, and not unfrequently cut through the base of the tongue and epiglottis.

Trachea.—All openings made *surgically* into the air passage are made in the *middle* line, for the very important reasons that the muscular coverings of the trachea do not unite in the mesial line, but merely approximate, leaving a cellular interval, through which the windpipe is reached, and, moreover, that normally no arteries exist in median line. Unless the middle line be adhered to, although the trachea may be opened, great difficulty will probably be experienced in the introduction of the tube, as it will have a tendency to slide between the muscles and the trachea, and miss the opening made in it. Again, supposing no difficulty to arise of this nature, the muscles may be so much wounded as to be seriously impaired, and become united to the integument after the tube is removed.

Nerves.—The superior laryngeal nerve lies deep down in this region, passing behind the external and internal carotids, and divides into two branches—an external supplied to the crico-thyroid muscle, and a deep one penetrating the thyro-hyoid membrane and distributed to the mucous membrane of the larynx (*vide* "Subclavian Artery").

This region is of great surgical importance: as well as being the usual seat of injuries inflicted suicidally or homicidally, the operations of thyrotomy, laryngotomy, cricotomy, tracheotomy, and œsophagotomy are performed therein.

The windpipe may be opened by:—

Thyrotomy, in which the thyroid cartilage is open

n the mesial line, and its alæ separated for growths or mpacted foreign bodies.

Laryngotomy, in which the crico-thyroid membrane s divided; this is the readiest method of admitting ir, the only complication which might arise being hæmorrhage from the crico-thyroid arteries, which run across this space. The incision in the membrane, which is made horizontally, must not be so wide as to injure the crico-thyroid muscles.

Tracheotomy is the operation in which the rings of the trachea are divided either above or below the isthmus of the thyroid body.

It must be borne in mind that, although the trachea is very superficial above, it recedes, and is very deep below, and just above the sternum is generally at least an inch from the surface, its depth varying according to the amount of fat or muscle in the individual, or to the curvature of the cervical vertebræ. Occasionally the rings are ossified in old persons, and may cause trouble.

In *children*, owing to the shortness of the neck, and the depth, small calibre, and mobility of the trachea, the operation is a difficult one. Again, the plexus of veins in connexion with the thyroid body and the closeness of the carotids, render it one demanding the greatest care. The innominata is proportionably higher up in the neck than in the adult, on account of its obliquity.* In children under two years of age, and in some who are far older, the thymus gland may give great trouble by bulging up into the wound, and so obstructing the operator's view of the parts.

The variations in the relation of the position of the thyroid body to the manubrium sterni in adults and children are important.

In children up to the twelfth year, when the larynx is undeveloped, the space between the lower border of the gland and the manubrium is larger than that

* In a case in the author's practice, the innominata in an *adult* held this position, and had to be carefully hooked aside before the completion of *the operation*.

between the upper border of the gland and th bone. In adults, where the laryngeal appar developed, the space is so small that as a rule th is under the sternum, or may pass behind it, w children the *thymus* gland crops up over the manu Consequently in adults, and particularly in mal exposure of the trachea above the isthmus is to difficult, and should the gland pass down beh sternum, there is a possibility of wounding t innominate artery or infra-thyroid vein.

This variation in the position of the gland i women is similar to that in children under p and has obviously an influence on the choice of of operating.*

The absence of arteries in the middle line, almost uniformly the case, shows that there is prehension of danger in the middle line from rhage than laterally. The thyroidea ima is th one which would be met with in such a plane, a is found in one in every ten bodies. As thi takes its origin in almost every instance from nominata, its distribution must be looked fo what to the right of the middle line. As the lies further distant from the surface of the bo descends, the operation of tracheotomy is ea performance the nearer the surgeon approach larynx. Consequently, unless there are contra tions, it should be performed above the thyroi It must be recollected that this gland should be downwards by a blunt instrument in order to freely the upper rings of the trachea, a proceeding una with difficulty, owing to the mobility of the Should the operation be performed below the body, there is considerable depth of tissue through before reaching the trachea, and, m great attention must be paid to the position vessels of the neck. The position of these tr

* *Linhart*: "Compendium der Chirurg. Operationsle

not so constant that any general rule for their distance from the upper edge of the sternum can be given.

In the performance of tracheotomy, there is a variation in the relative position of the trachea and the anterior surface of the neck in the different positions of the head. During extreme extension of the head, the trachea is brought considerably nearer the surface of the neck, and is consequently more accessible. Moreover, the field of operations is much more extensive than when the chin is in the usual position of depression.*

Foreign bodies in the trachea are naturally directed towards the *right bronchus* because it is wider than the left. The septum at the bottom of the trachea, which separates the bronchi, occupies the left of the median line.

The bifurcation of the bronchi takes place in front of the interspace between the third and fourth dorsal vertebræ.

The right bronchus is shorter and more horizontal than the left, being about one inch long. The left is about two inches in length, and is directed more obliquely than the right.

SURGICAL RELATIONS OF THE ŒSOPHAGUS IN THE NECK.

The œsophagus is occasionally the seat of operation, such as the removal of some foreign body, the passing of bougies in cases of stricture, or introducing the tube of a stomach-pump. The operation of *œsophagotomy* is required but rarely, but it may be had recourse to in such cases as impaction of foreign bodies, when the substance can neither be pulled out through the mouth, nor pushed downwards into the stomach, or in such a case as where a substance might be removed through a longitudinal wound in the œsophagus, but could not be drawn

* Braune: "*Topographish. Anat.* Atlas," translated by author.

through the more constricted portion of the tube—as for instance, a set of false teeth, etc., or in cases of stricture.

In the neck, it commences as a constriction below the pharynx, having at this point the cricoid cartilage in front, and the fifth cervical vertebra behind it. It terminates opposite the eleventh dorsal vertebra.

Just at first, it lies in the mesial line of the body, but as it approaches the root of the neck it inclines towards the left side of it.

In front of it lie the trachea, the left lobe of thyroid body, and the thoracic duct.

Behind, left longus colli, the cervical vertebræ and a layer of loose cellular tissue, and the deep layer of cervical fasciæ.

At the sides, the common carotid vessels, the left being nearer, the thyroid body, and the recurrent laryngeal nerves.

Great care must be taken, in passing bougies or tubes through the mouth into the œsophagus, to keep the end of the instrument well against the spine, and to use very gentle pressure, as false passages are readily made (especially where there has been any disease) into the pleural cavity, posterior mediastinum, or pericardium.

The operation of œsophagotomy is thus performed. An incision is to be made on the left side of the neck, about four inches long, along the anterior border of the sterno-mastoid, as though for ligaturing the common carotid artery above the crossing of the omo-hyoid. The omo-hyoid, sterno-hyoid, and sterno-thyroid muscles are to be drawn inwards, and the sheath of the vessels, intact, drawn outwards; the œsophagus is then seen at the bottom of the wound, when a longitudinal incision is to be made upon the foreign body or bougie as it lies in the tube.

The *structures to be avoided* are—the sheath of the vessels, the thyroid vessels, the thyroid body, and the *laryngeal* nerves.

The occipital portion of the side of the neck, that bove the crossing of the omo-hyoid, possesses few oints of surgical importance beyond its being the eat of tumours. Its boundaries are—in front, the terno-mastoid; behind, the trapezius; and below, the mo-hyoid; its floor is formed by the upper portion of he anterior scalene muscle, the middle and posterior calene, the levator anguli scapulæ and splenius olli muscles. The spinal accessory nerve emerges rom the junction of the upper and middle third f the posterior border of the sterno-mastoid nd crosses the region obliquely, to enter the tra- ezius, accompanied by descending muscular branches f the cervical plexus; the superficial branches of the ervical plexus are seen passing upwards (small ccipital) along the posterior border of the sterno- nastoid, forwards (great auricular and transverse ervical) across it, and downwards (descending cervical). There are a great many lymphatic ganglia along the osterior border of the muscle, and the integument is very tough and fibrous.

SURGICAL ANATOMY OF THE STERNO-MASTOID REGION.

Topography.—The boundaries of this region may be sufficiently stated as being those occupied by the sterno-cleido-mastoid muscle itself. This muscle forms an oblique rectangular eminence, and is attached above to the mastoid process and the superior curved line of the occipital bone, its broad tendinous *insertion* being blended with the fibres of origin of the trapezius; passing downwards and forwards, its muscular fibres become divided, the anterior set collecting themselves into a round fusiform bundle, to be attached to the manubrium sterni, and a posterior bundle, a flattened riband-like band, separated from the former by a cellular interval, and attached for a variable distance along the inner and upper *aspect of the clavicle*. (Occasionally these clavi-

cular fibres pass along the whole inner two-thirds of the clavicle, forming a muscular layer, almost covering in the posterior triangular space.) This interval in the disposition of the muscular fibres is of great surgical importance. The anterior border is the more prominent, and is rounder than the posterior, which becomes lost in the general surface of the posterior part of the neck. In most works on descriptive anatomy it is not sufficiently enforced that this muscle completely covers in the common, internal, and external carotids, and that while the muscle, its integuments, and the fascial coverings are intact, it may surgically be considered to extend forwards as far as the angle of the jaw. The pulsations are in reality felt beneath its anterior border, or immediately beneath its sternal and clavicular attachments.*

Topography.—Structures superficial to the sterno-cleido-mastoid.—Beneath the skin and cellular tissue the first structure met with is the platysma, passing obliquely backwards from the jaw to the shoulder, and below this layer of muscular tissue the structures met with are, some filaments of the small occipital nerve, the great auricular nerve, the external jugular vein, which usually crosses the muscle obliquely at about its middle, to pass ultimately into the subclavian vein, the transverse superficial cervical nerve, passing forwards to the under surface of the platysma and integument, and some branches of the descending clavicular nerves. The disposition of the fibres of the platysma, as far as regards the direction of the external jugular vein, is important, as in venesection it is necessary to cut *across* them, and not in their continuity, otherwise the wound would close from muscular contraction. That portion of the cervical aponeurosis which forms the anterior layer of the sheath

* According to Richet it is impossible to puncture the common carotid from the side of the neck without perforating the sterno-mastoid. This is true in the normal position of the head, but if it be turned to either side the traction upon the sheath of the vessels *causes it* to emerge beyond the edge of the muscle.

of the muscle is next seen, attached above to the angle of the jaw (almost appearing to divert the anterior

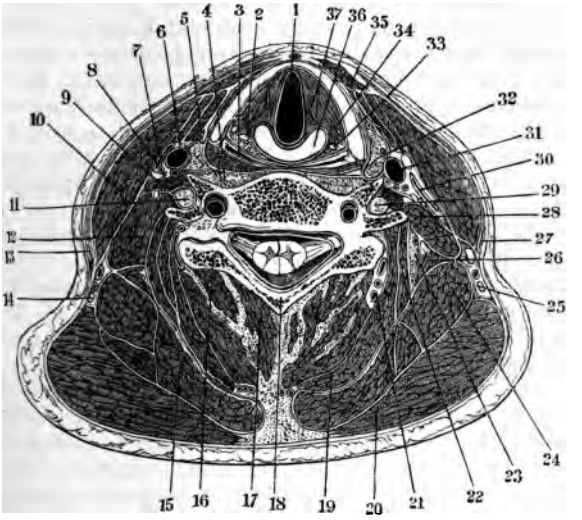


Fig. 16.—Section of Neck through the Sixth Cervical Vertebra (one half).

1, larynx; 2, recurrent laryngeal nerve; 3, pharynx; 4, longus colli muscle; 6, descendens noni; 7, vagus; 8, phrenic nerve; 9, scalenus anticus; 10, sterno-cleido-mastoid; 11, brachial plexus; 12, scalenus medius; 13, external jugular vein; 14, spinal accessory nerve; 15, splenius; 16, part of articular surface of seventh cervical vertebra; 17, semi-spinalis and multifidus; 18, sixth cervical vertebra; 19, biventer cervicis and complexus; 20, trapezius; 21, profunda cervicis vessels; 22, transversalis cervicis and trachelo-mastoid; 23, cervicalis ascendens; 24, levator anguli scapulæ; 25, spinal accessory nerve; 26, scalenus posticus; 27, external jugular vein; 28, scalenus medius; 29, brachial plexus; 30, internal jugular vein; 31, common carotid artery; 32, thyroid gland; 33, muscular process of the thyroid cartilage; 34, crico-arytenoid lateralis; 35, sterno-hyoid (just posterior are seen the thyro- and omo-hyoid muscles); 36, cricoid cartilage; 37, thyro-arytenoid muscle.

border of the muscle from the straight line), and below to the *clavicle, and to the* corresponding fascial sheath

of the opposite muscle; and after completely enc the muscle at its posterior border, it becomes conti with the aponeurosis of the neck.

The sterno-cleido-mastoid is perforated on its surface, near the centre, by the spinal accessory n which enters it obliquely and, after inosculating substance with the second and third cervical n passes out behind its posterior border, and crosse posterior triangular space. The muscle is readily in action, on rotating the head, or on bowing it upc thorax, when *both* muscles are used.

Parts beneath the sterno-cleido-mastoid.—Immed behind the muscular fibres, is the posterior layer sheath; and between it and the muscle lie a con able number of lymphatics, and some twigs o sterno-mastoid branches of the superior thyroid and veins.

The most convenient method of grouping structures which lie beneath the muscle is to div into three portions making the crossing of the hyoid to separate the middle and lower, and drawn backwards from the angle of the jaw to se its middle and upper. Beneath the posterior la the sheath in the upper third, from above down the structures met with are—the insertion o splenius capitis, beneath which are the attachme the posterior belly of the digastric and of the tra mastoid, the posterior auricular and occipital v the external border of the complexus, while deeper are the attachments to the atlas, of the o and rectus lateralis muscles, the vertebral artery sub-occipital nerve. In the middle third, p obliquely into the under surface of the muscle, i spinal accessory nerve, which unites with som ments of the cervical plexus; next appear, a of lymphatic glands (*glandulæ concatenatæ*), branches of origin of the superficial cervical p the descendens, and communicans noni n *Beneath* them lie the common internal and ex

carotid arteries and jugular vein, the hypoglossal nerve, the vagus, the superior cervical ganglion of the sympathetic, and deeper down upon the spinal column the attachments of the rectus anticus major, scaleni, levator anguli scapulæ, and splenius colli muscles. Next is the crossing of the omo-hyoid, and in the inferior third from within outward are the outer borders of the sterno-hyoid and thyroid muscles, covered by their aponeuroses, with the nerves supplying them. Posteriorly and externally are the scaleni and the cervical plexus, the phrenic branch of which lies on the anterior scalenus, having the ascending cervical artery lying parallel and internal to it. Beneath the scalenus anticus are the third part of the subclavian artery, a quantity of lymphatic ganglia, and, enclosed in their proper sheath, lying obliquely, in the middle of this space, the common carotid artery and the internal jugular vein which joins the subclavian vein below; into the junction of which pass, on the right side, the common lymphatic trunk, and on the left the thoracic duct with its tributaries. Posteriorly, are the vagus and the recurrent laryngeal nerves, and closer down on the spine the cord of the sympathetic and the middle cervical ganglion, lying on the prevertebral aponeurosis. Posterior to the carotid vessels and below, is that portion of the *subclavian artery* which lies internal to the anterior scalenus. This vessel, on the right side, arises from the innominata, and lies immediately behind the inferior angle of the divergence of the sternal and cleidal origins of the cleido-mastoid, and is separated from the sterno-clavicular articulation and origins of the sterno-hyoid and thyroid muscles, by the junction of the internal jugular and subclavian veins. The vagus and phrenic nerves lie in front of it, with numerous branches of the sympathetic; whilst embracing it, and passing behind it, is the recurrent laryngeal nerve. Behind it is the transverse process of the seventh cervical vertebra, and internally the *common carotid itself;* below and externally, this

portion of the subclavian artery is in relation with t pleura.

The branches of the *subclavian artery* being r mally derived from the first part of its course, it lows that on the right side these branches lie bene the clavicular portion of the sterno-cleido-mast muscle; and this fact, added to the mechanical d culty of reaching it, forms a serious obstacle to succ on placing a ligature upon it in this situation. In event of the operation being undertaken, it sho be tied as near the vertebral as possible, so tha coagulum may be formed between this point and origin of the trunk.

On the *left* side the recurrent laryngeal is not relation with the subclavian artery in the n (*vide* "Subclavian Artery").

COMMON CAROTID ARTERY.

As referred to the surface, the course is represen by a line drawn from the sterno-clavicular articulati to the external aspect of the upper border of thyroid cartilage, at which level generally it divi into external and internal carotid.

From a surgical point of view, it is advisable divide the carotid region into three distinct portio an inferior, a middle, and a superior; the first t corresponding with the common carotid artery, and t latter with its bifurcations.

Inferior portion.—In this portion, the left comm carotid in the neck is a little deeper and rather lon than the right.

In front of it lie successively the integume platysma, sternal origin of sterno-mastoid, sterno-hyo sterno-thyroid, omo-hyoid, in their aponeurotic sheat the anterior jugular, and a portion of the brach cephalic veins. It corresponds with the interval t tween the two heads of the sterno-cleido-masto *and advantage* is taken of this to apply a ligature

the vessel at this point below the crossing of the omo-hyoid.

Externally: Internal jugular vein, vagus nerve, and lymphatics.

Internally: Trachea, thyroid body, recurrent laryn-

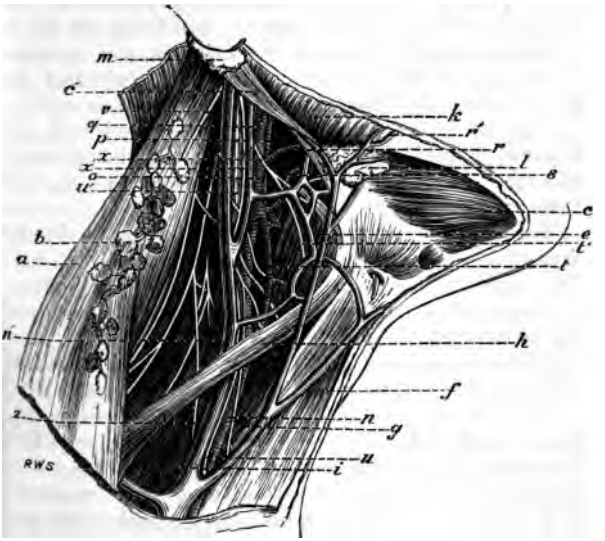


Fig. 17.—Common Carotid Artery and its Branches.

a, sterno-mastoid reflected; *b*, glandulæ concatenatæ; *c*, anterior belly of digastric; *c'*, posterior belly of digastric; *e*, thyro-hyoid; *f*, sterno-thyroid; *g*, sterno-hyoid; *h*, omo-hyoid; *i*, anterior scalenus; *k*, masseter; *l*, submaxillary gland; *m*, parotid gland; *n*, Common carotid; *n'*, internal jugular vein (joined by the anterior jugular and supra-scapular); *o*, external carotid; *p*, internal carotid; *r*, facial; *r'*, facial vein; *s*, lingual; *t*, superior thyroid; *t'*, nerve to thyro-hyoid; *u u'*, vagus; *v'*, spinal accessory nerve; *x*, hypoglossal nerve; *x'*, descendens noni nerve; *z*, phrenic nerve.

geal nerve, inferior thyroid artery, larynx, and pharynx.

The middle portion is the seat of election for ligature

of this vessel, and it lies in its sheath with its ve and nerves at the bottom of a well-marked furrow the neck, and is here most superficial. This furrow formed by the sterno-mastoid externally, and t laryngo-tracheal tube internally.

In front are merely the common integuments a the slight over-lap of the sterno-mastoid and its fasc

Externally, the internal jugular vein and comm carotid artery are covered by the omo-hyoid and t loop between the descendens and communicans noni.

Behind, the vessel is crossed by the vertebral a inferior thyroid arteries, and it lies on the anter tubercles of the transverse processes of the cervi vertebræ, notably the sixth.

The vagus nerve also lies behind the vessels in t furrow between them and in their common shea This must be borne in mind in applying a ligatu The sympathetic lies quite posterior and in the de fasciæ covering the prevertebral muscles.

The superior portion.—This contains the bifurcati of the vessel into external and internal.

The external carotid artery is given off from t main trunk, usually opposite the upper border of t thyroid cartilage; it is at first a little *internal* to, a in front of, the *internal* carotid, and passes upwa and forwards, and afterwards a little backwards, wards the angle of the jaw. Up to the level of a li drawn from the mastoid process to the hyoid bone t artery is superficial, but at this point it gets deep being crossed by the ninth nerve, the posterior belly the digastric and stylo-hyoid muscles and a plexus veins; it then enters the lower border of the paro gland.

The branches of the external carotid are usua given off in the following order:—the superior thyro the ascending pharyngeal; the lingual; the facial; t occipital; the posterior auricular; and it termina in the temporal and internal maxillary.

Relations of external carotid.—In front: Integume

na, and fasciæ, sterno-mastoid, hypoglossal nerve, and facial veins, posterior belly of digastric and yoid muscles, and parotid gland.

ind: Superior laryngeal nerve, styloid process, lossus and stylo-pharyngeus muscles, glosso-geal nerve, and that portion of the parotid gland separates it from the carotid.

rnally: Hyoid bone, pharynx, parotid, ramus of d stylo-maxillary ligament.

internal carotid artery (*cervical portion*) arises e the upper border of the thyroid cartilage, and first superficial and external to the external , until the crossing of the digastric, where it s deeper and lies beneath the external carotid. y it gives off no branches in the neck, and is than the external in the child, but of much the alibre in the adult.

tions of the cervical portion of the internal .—In front: Integument and platysma, sterno-d, parotid, hypoglossal nerve, styloid process, lossus, and stylo-pharyngeus muscles, glosso-geal nerve and its branches.

rnally: Internal jugular vein, and vagus nerve.

rnally: Pharynx, ascending pharyngeal artery.

ind: Rectus anticus major muscle, sympathetic, perior laryngeal nerves.

region is the seat of most important operations ligature of the common carotid arteries or their es, of the subclavian in the first part of its of the innominate, of œsophagotomy, the l of tumours, and opening of abscesses.

ries, such as stabs, etc., to those large vessels inferior and middle regions, are of the gravest and the diagnosis of the actual vessel ed is very difficult, and sometimes absolutely ible. For instance, a wound inflicted by a l instrument might involve the common carotid, tebral, or the inferior thyroid, or all of them.

point of bifurcation of the common carotid is

the most common seat of aneurisms, here the method of treatment of placing a ligature between the sac and the heart, and as far as possible away from the origin of the subclavian, is to be preferred.

In cases of *wound* of the *internal jugular vein*, a ligature should be applied above and below the point; injuries of this kind are usually fatal; but it sometimes happens that the vessel may be punctured during an operation without any very serious result, the circulation being readily re-established in the venous system of the head and neck.

With regard to the injuries to the superior portion of the neck, and the application of a ligature, there is great difficulty of recognizing the external from the internal carotid artery in the wound, and a good method is to bear in mind that the latter gives off no branch on the neck, and, moreover, that the hypoglossal nerve crosses the vessel obliquely, and is in immediate contact with the external which lies highest. Again, we may try whether by compressing the exposed vessel the temporal pulse stops or not.

Ligature of the common carotid artery.—In applying a ligature to the common carotid, that portion of it which lies either immediately above or immediately below the crossing of the omo-hyoid should be selected, as the vessel is there most easily reached.

Above the omo-hyoid.—The incision to be made varies in length, according to the nature of the case, and the depth of the subjacent structures, but is usually one about three inches in length, along the anterior border of the sterno-mastoid, from just below the angle of the jaw to the cricoid cartilage, dividing the integument, superficial fascia, and platysma; the wound being kept open by retractors, the deep fascia is observed, this is very adherent to the sheath of the vessels; a plexus of veins, and a few small arterial twigs, are often interspersed between it and the sheath. *This fascia* should be cautiously divided on a director,

so as to expose the sheath, upon or beneath which is the descendens noni nerve.

Next a small portion of the sheath is to be pinched up and "nicked," by holding the blade of the knife horizontally, immediately over the inner aspect of the vessel, as far from the vein as possible; and an aneurism needle is to be passed *from without, inwards,* and kept closely round the artery, so as to avoid wounding the internal jugular vein or including the pneumogastric nerve. There is a tough layer of areolar tissue between the sheath and the artery, which must be gently "teazed" through, by the needle, on being pushed against the finger nail. The jugular vein may be compressed above and below during the operation, as it is liable to become suddenly so distended as to conceal the parts. Should any difficulty in reaching the vessel be met with, owing to engorgement of the veins, an important landmark will be found in the anterior tubercle of the transverse process of the sixth cervical vertebra, which is behind and a little internal to the carotid artery, and against this the carotid may be compressed. (Chasaignac's tubercle.)

Below the omo-hyoid.—Tying the vessel *below* the omo-hyoid is much more difficult, owing to its greater depth, and to the size of the veins. An incision should be made about three inches in length from the cricoid cartilage, along the anterior border of the sterno-cleido-mastoid (which is to be drawn outwards), taking care to avoid wounding the lower sterno-mastoid artery and the middle thyroid vein; the fascia covering the sterno-hyoid and sterno-thyroid muscles is next seen, and must be cautiously divided, and these muscles pulled inwards, the sheath being reached (upon which are branches of the loop of the descendens and communicans noni nerves) is to be opened, and the needle passed *from without, inwards.* The inferior thyroid artery and sympathetic and recurrent laryngeal nerves lie immediately *behind the* vessel in this part of its

course. It must be borne in mind that, on the ri side of the neck, at its lower part, the inte jugular vein diverges from the artery; but on the approaches it, and sometimes crosses it, owing to formation of the innominate veins. As before n tioned, advantage may be taken of the natural in space between the two heads of origin of the ste mastoid to place a ligature on this portion of vessel, but it is very difficult for the reason just sta Another method of reaching it is to expose and di the sternal attachment of the sterno-mastoid, the obtaining greater room and corresponding safety.

Collateral circulation after ligature of the com carotid.—Supposing the vessel to be normal—that i say, that it gives off no branch before the usual furcation, the collateral circulation is very free, an re-established by vessels both without and within cranium; thus the current of blood being arreste the carotid, the subclavian of the same side bec dilated, the work outside the skull is thrown t the inferior thyroid branch of the thyroid axis, superior thyroid branch of the external carotid, profunda cervicis of the superior intercostal, and princeps cervicis of the occipital; the vertebral d the work of the internal carotid, *within* the skull.

Ligature of the external carotid artery.—An inc is to be made similar to that for tying the com carotid above the omo-hyoid, where the vessel is superficial, and immediately beneath the skin, platy and superficial fascia, and a complicated plexu veins. The posterior belly of the digastric and attendant muscle, the stylo-hyoid, should be d upwards towards the jaw, and the sterno-ma outwards; the superior laryngeal branch of the v lies usually just behind its short trunk.

The collateral circulation after ligature of the ext carotid would be readily maintained by its bran anastomosing so freely on the face with those of *opposite* side, and by the terminal branches of

l carotid (supra-orbital, ethmoidal palpebral, sal) with the facial, and by the profunda and s cervicis.

tomy.—The attachments of the sterno-cleido- l to the clavicle and sternum occasionally re- livision, *subcutaneously*, for the relief of wry- · *torticollis*, and considerable caution is requisite apparently simple operation, as there is a danger nding the external jugular vein as it passes into ernal jugular, or even more important vessels, if ;lumsily or hastily performed. The division be made about three-quarters of an inch above vicle.

CAL ANATOMY OF THE SUBCLAVIAN REGION.

ace markings.—The hollow which exists above ehind the clavicle is almost invariably well- l, even where there is a considerable quantity of he neck; and it is this space, with its numerous ts and varying conformation, which is of such l import. This hollow corresponds with the apex lung, hence the necessity of auscultation at this when there is any suspicion of tubercle. It is d anteriorly by the posterior border of the sterno- mastoid; behind, by the rounded anterior border trapezius—these muscles nearly meet above at ranial attachment, where their aponeuroses are d; below by the clavicle, and above by the g of the posterior belly of the omo-hyoid, and or is formed by the first rib and the muscular res attached to it.

pulsation of the subclavian artery can be felt bottom of the space as it crosses the first a which it can be readily pressed for any on about the shoulder or arm. The positions scalene muscles, the cords of the brachial plexus, larly those of the fifth and sixth, and the course *omo-hyoid, are also* felt, and generally to be

seen, as eminences beneath the integument. ... be borne in mind that the "triangle" formed ... crossing of the omo-hyoid is a result of *dissecti* ... the detachment of its aponeurosis; no such ... interspace existing during life, the inner borde ... muscle lying behind the clavicle, and its upper ... only, being seen whilst in action. The chang ... appearance of the hollow immediately above and ... the clavicle is noticeable under certain circum...

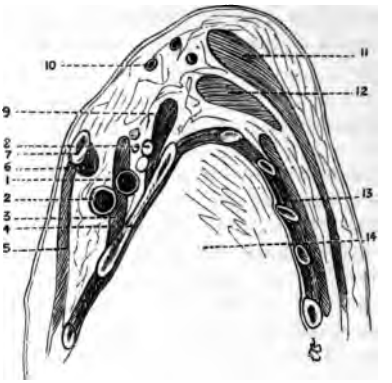


Fig. 18.—Diagrammatic Section through the Centre of ... Clavicle, showing the relation of the subclavian vessel ... antero-posterior direction.

1, subclavian artery; 2, subclavian vein; 3, anterior ... muscle; 4, first rib; 5, pectoralis major; 6, subclavius ... 7, clavicle; 8, cords of brachial plexus; 9, scalenus ... 10, transversalis colli artery; 11, trapezius; 12, levat ... scapulæ; 13, rhomboid; 14, cavity of thorax.

thus, in *inspiration*, it is considerably deeper ... during *expiration* becomes flatter, when the ... the subclavian *vein* is generally visible. Ag... various movements of the arm and of the clavic... considerable modifications of its form, and t... tions of its contents—facts of great importanc... *surgeon*. The presence of a cervical rib on the

ervical vertebra, by throwing up the subclavian artery, night lead to a suspicion of aneurism.

Compression of the subclavian artery is generally ecessary in amputations about the upper arm, and ery slight pressure is requisite. The thumb or finger s to be slipped just behind the posterior border of the terno-mastoid, where it is attached to the clavicle, and n slight pressure being made in a *vertical* direction to he axis of the body, the pulsation of the vessel is elt; a little further pressure at the pulsating point ompresses it against the first rib, and does not inter- re with the circulation in the subclavian vein. The rculation may be controlled also, in many instances, y drawing the arm backwards, and forcibly depressing ie tip of the shoulder.

Topography.—Beneath the skin is the superficial scia, which is attached above to the superior curved ne, and below to the anterior border of the clavicle id sternum. The first structures met with, are the escending superficial branches of the cervical plexus he acromial and clavicular), and a considerable number f lymphatic glands. Beneath the layer of the cervical scia which covers in the space is a quantity of loose ellular tissue and fat, in which lie lymphatics and super- icial cutaneous and glandular vessels. The upper border f the omo-hyoid, enclosed in its sheath of deep cervical scia, is next met with, the anterior layer binding down he subclavian vein against the clavicle, which vein here eceives the external jugular just behind the attach- ment of the sterno-cleido-mastoid. This lamina of fascia is very strong, and by its resistance determines the passage of pus between it and the superficial layer, causing it to point superiorly. The deep cervical fascia in this region covers in the splenius, levator anguli scapulæ, the scalenes, the cervical and brachial plexuses, and the subclavian artery and vein (*vide* "Cervical Fasciæ"). Purulent collections developed between this and the preceding lamina do not point in the axilla; *but in the* case of abscess dependent on

caries of the lateral portions of the cervical vertebræ, the pus would follow the course of the brachial plexus and pass into the axilla. Immediately behind the vein, internally, is the anterior scalene muscle; and

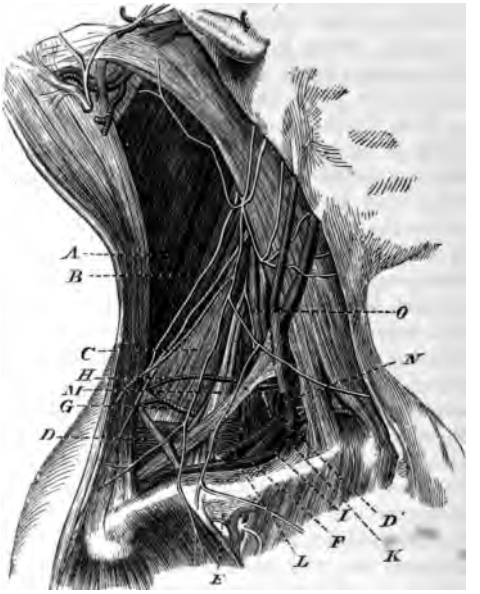


Fig. 19.—Region of the third part of the Subclavian Artery (the shoulder represented depressed).

A, splenius; B, levator anguli scapulæ; C, scalenus posticus; D, first serration of serratus magnus; E, costo-coracoid membrane and cephalic vein; F, subclavian artery; G, transversalis colli artery (deep); H, a more superficial branch; I, supra-scapular artery; K, subclavian vein; L, supra-scapular vein; M, brachial plexus; N, Scalenus anticus; O, phrenic nerve.

emerging from behind this, and meeting the vein at an acute angle in a plane superior to it, is the subclavian artery; and in a plane more posterior, but above, are the cords of the brachial plexus. The anterior scalene

uscle is inserted into a tubercle (*the scalene tubercle*) 1 the first rib, which is a guide to the vessel, and in ont of, and behind the tubercle are grooves on the b, in which lie, in the anterior, the subclavian vein, id, in the posterior, the subclavian artery, separated om each other by the muscle. The supra-scapular tery, a branch of the subclavian in the first part of its ourse (normally), with its vein, crosses the main trunk ist below the crossing of the omo-hyoid, and lies ong the upper border of the clavicle. The transersalis colli artery, also a branch of the main trunk in ie first part of its course, lies superior to the artery, ut beneath the cervical plexus it passes towards the apezius, to reach the posterior border of the scapula. hese vessels are accompanied by veins, forming a lexus, which lies superficial to the artery, and may ause considerable difficulty in any operation in this gion.

The subclavian artery is divided into three portions; arises on the right side from the innominata, and n the left from the aorta.

Relations of the subclavian artery in the first part of s course—

The ascending portion—internal to the scalene muscles, rather shorter on the right than the left side, is eparated from the sterno-clavicular articulation by the terno-hyoid and sterno-thyroid muscles, and commencement of the innominata veins—in the right and eft side the relations are different:—

On the right side, in front, are the subclavian vein and the vagus, the trunk of the sympathetic and phrenic nerves; *externally,* the pleura and apex of lung; *posteriorly,* the transverse process of the seventh cervical vertebra, and the recurrent laryngeal nerve.

On the left side.—The vessel is at first deep, and follows the left side of the vertebral column; between it and the common carotid lie vagi and phrenic nerves, it next lies on the pleura, and is crossed at right angles by the *subclavian vein.*

Relations of the subclavian artery in its se portion—

These are the same on both sides; it here between the scaleni on the first rib, and has the c of the brachial plexus above and behind it.

Relations of the subclavian artery in the third of its course—

In front.—Integument, superficial cervical fa platysma, external jugular vein, and the venous pl before mentioned, descending cervical nerves, su vius muscle, supra-scapular artery, and clavicle.

Above.—Brachial plexus, and posterior belly of hyoid muscle.

Below.—First rib covered by the first serratio the serratus magnus.

Behind.—The middle scalene muscle. The ar branches given off are superior—the vertebral superior thyroid.

Ligature of the subclavian artery in the third pa its course.—The point selected for placing a lig upon this vessel is just where it lies on the firs at the bottom of the hollow above described. not enclosed in a definite sheath like the carotid is bound down by a process of the deep cer fascia, derived from the aponeurotic investment o omo-hyoid. The incision is most advantage made, by drawing the integument down, and cu upon the clavicle, allowing it to retract afterw but this proceeding must be modified by ci stances. When the vessel is reached, just emerges from behind the anterior scalene muscl needle must be passed round it from *within, outw* and the end of the needle must be made to insi itself round the vessel closely, so as to avoi united cord of the eighth cervical and first nerves, which lie immediately behind it.

The collateral circulation developed after ligat the third part of the subclavian artery, is as follo

As the third portion rarely gives off any bra

od would pass towards the arm by the supra- and posterior scapular branches of the thyroid astomosing directly with the dorsalis scapulæ xillary, on the dorsum scapulæ. The internal ry trunk of the subclavian anastomoses with omio-thoracic, long thoracic, and subscapular, superior intercostal with the superior thoracic.

GICAL ANATOMY OF THE INNOMINATA.

ough the innominata, anatomically speaking, to the thorax, yet any surgical proceeding in on with it would be attempted in the lower the carotid region; hence it has been thought e to introduce it into the surgical anatomy of k.

e *neck* it, normally, ascends obliquely in the ide to the posterior aspect of the sterno- ar articulation, where it divides into the right an and common carotid arteries, and is about , or rather more, in length.

ions.—From before backwards the structures ; it are—skin, fascia, some fibres of platysma, ending branches of cervical plexus, sternal origin o-mastoid, a portion of the manubrium sterni, of the sterno-hyoid and sterno-thyroid muscles, of thymus gland, left innominate, and right thyroid veins, and cardiac branches of vagus.

ts outer side lie the right innominate vein, nd pleura; on its inner, the remains of the gland, and commencement of the left common and behind it is the trachea. It occasionally higher in the neck than at the sterno-clavi- ticulation, and may be seen pulsating. Its must be carefully made out in performing omy, particularly in children, where the space a the operation is feasible is very limited, and ctures very close together, besides which the is *very small* and moveable. It sometimes

gives off a branch to the thyroid body (the ima), which might lie immediately over the deep incision in tracheotomy; and occasiona off thymic and bronchial branches.

Ligature of the innominata.—In order to vessel for the purpose of ligaturing it, it mus out as much as possible from the deep occupies, by raising the shoulders and thro the head. Next, the sternal origin of the st mastoid is to be exposed, by an incisio anterior border, met by one along the upper sternum; this tendon is to be divided, and lying origins of the sterno-hyoid and thyr carefully divided. Beneath these muscula plexus of veins, chiefly derived from t thyroid, which must be hooked aside. cervical fascia is next to be cautiously scrap and the origin of the common carotid exp vessel serves as the guide to the trunk nominata. The left innominate vein must down, whilst the right innominate and inte veins, with the vagus nerve, are drawn outw needle must be passed from *below, up inwards*, taking care that it is kept close to to avoid wounding the right pleura or tra lie behind it. The ligature should be appl up as possible. The vessel may be reac incision in the mesial line of the jugulo-tra and this incision should pass immediately i between the sterno-thyroid, and thus divid cervical fascia to which the great veins are attached; if this be done, the vessel can from the trachea.

Collateral circulation developed after lig innominata.—The right side of the hea would be supplied with blood by the inc the carotids with those of the opposite si circulation in the right subclavian w established by means of its intercostal br

lating with the first aortic intercostal, assisted by the intercostal arteries, inosculating with the internal mammary, long thoracic, superior thoracic, and acromio-thoracic, and by the inosculation between the superior thoracic and deep epigastric.

REGION OF THE NAPE OF THE NECK (POSTERIOR CERVICAL REGION).

This region extends from the occipital tuberosity and superior curved lines above, to the seventh cervical vertebra below, and is bounded laterally by the trapezius. The spinous processes of the three last cervical vertebræ can be felt through the integument, the seventh receiving the name of *vertebra prominens*. The integument is very tough and strong, containing a great deal of fibrous tissue, and not very vascular, and is a favourite seat of abscess or carbuncle; the subcutaneous cellular tissue contains a good deal of fat, and is united to the ligamentum nuchæ, a tough fibro-elastic mass, extending from the occipital tubercle to the seventh cervical vertebra, separating the muscles on either side of the neck. Beneath the aponeuroses lies the trapezius, the aponeurotic attachment of which superiorly is blended with that of the sterno-mastoid; and separating these muscles from the succeeding layer is a dense fascia, continuous with the dorsal aponeurosis, beneath which are found the splenius capitis and the levator anguli scapulæ, the upper portion of the rhomboidei, and serratus posticus superior; next the complexus, the trachelo-mastoid, and transversalis colli. In the fat and cellular tissue beneath this layer are several vessels of importance in the maintenance of the collateral circulation after ligature of the subclavian or carotid arteries—namely, the occipital, vertebral, profunda, and princeps cervicis. The *occipital* enters the region between the splenius capitis and obliquus superior, and lies between the splenius and the complexus, and is afterwards distributed to the scalp

its descending branch, the *princeps cervicis*, whi inosculates with the vertebral and the *profun cervicis* branch of the superior intercostal, pas between the complexus and semi-spinalis colli musc The profunda cervicis enters the region by passi backwards between the transverse process of t seventh cervical vertebra and the first rib. The *ner* found here are branches of the sub-occipital and t posterior branches of the great occipital, and third a fourth cervical nerves. Beneath the integument ar number of lymphatic ganglia, which become engor in constitutional syphilis. Beneath the cellulo-fa layer are the muscles forming the sub-occipital angle, the recti capitis postici, internally, the obliq superior and the obliquus inferior, the floor of wh triangle contains the curve of the vertebral art perforating the posterior occipito-atlantoid ligam before it takes its course through the foramen magn and between this vessel, and the groove in the atla the trunk of the sub-occipital nerve.

VERTEBRAL COLUMN IN THE CERVICAL REGIC

Owing to the curvature of the cervical spine, prominence of the second and third cervical vertebr the pharyngeal cavity can be readily recognized f the mouth by palpation.

The cervical spine is liable to dislocation from great mobility of the articulations, and, from the that the articular surfaces are nearly horizontal, location without fracture may take place. In the s between the first cervical vertebra and the occiput cord may be readily reached by a mere puncture—a which should not be forgotten by the medical le An injury to the cord above the third would impli the phrenic nerve and paralyse the diaphragm, and rise to sudden asphyxia, causing instantaneous deat

If the lower portion of the cervical cord be div *there will* be paralysis both of the upper and l

tremities, and the respiration would be entirely rried on by the diaphragm. If the injury be oppo- e the sixth cervical vertebra, there would be only rtial paralysis of the upper extremity, owing to that rtion of the brachial plexus given off from the cord ove this spot being unimplicated.

The cervical spine is occasionally the seat of *spina fida*, an arrest of development in which the spinous ocesses or the laminæ are absent or separated, lowing of the bulging of the meninges beneath the teguments. In spina bifida in this region, the spinal rd and its nerves are generally adherent to the arietes of the tumour. (For course taken by pus in pinal caries, *vide* "Fasciæ of Neck.")

CHAPTER III.

SURGICAL ANATOMY OF THE THORAX.*

THE applied anatomy of the thorax is rather the p vince of the physician than that of the surgeon, yet the same time there is so much in common with reg to physical examination, that it will be advisable devote some little space to the subject.

In the region of the thorax it is intended to incl that portion of the body comprising the parietes the chest, which contains the heart, lungs, and contents of the posterior mediastina. The interio bounded, *superiorly*, by the superior aperture of thorax (that is to say, the bony ring formed, behind, the body of the first dorsal vertebra; on either side the first ribs; and anteriorly, by the upper part of manubrium sterni); *anteriorly*, by the sternum; *teriorly*, by the vertebræ; *inferiorly*, by the diaphra and *laterally*, by the ribs and intercostal mus above the limit of the diaphragm, to the exclusio such structures as are regarded as belonging to upper extremity—namely, those entering into formation of the axilla, which region will be here described.

The general form of the thorax is that of an verted cone. It is flattened from before backward that it presents in section an ellipse, whose gr axis is transverse; in the child, however, this sec

* For the intimate relations of the contents of the thora student is referred to Braune's "Atlas of Topographical Anato (*Translated* by Author.)

almost circular. After the removal of the upper extremities, it takes the form of a right cone. The cavity enclosed by these limits is not of the same dimensions as that of the cavity contained merely within the bony limits, since the diaphragm represents an arch, mounting up as high as the fifth rib in front, so that some of the abdominal viscera (liver, stomach, spleen, transverse colon, pancreas, and duodenum) are hidden by the thorax. Hence the thorax and abdomen are so reciprocally united, that any instrument which traversed the thorax at its inferior part would, of necessity, penetrate both cavities.

The relation of the *structures passing through the superior aperture of the thorax* would seem to form a suitable connexion between the regions of the thorax and neck. Supposing a section be made, following a plane passing through the upper part of the first dorsal vertebra behind, the upper borders of the first ribs laterally, and the manubrium sterni anteriorly, the following structures would be seen passing from before backwards, between the apices of the lungs. In the middle line are the origins of the sterno-hyoid and sterno-thyroid muscles, and a lax cellular tissue, in which are the remains of the thymus gland, the inferior thyroid veins, the trachea, œsophagus; and, in the groove separating them, the recurrent laryngeal nerves; and on the left side the thoracic duct. At the sides the internal mammary vessels, the innominate veins, and on the right the innominate artery, with the vagus nerve lying between it and the innominate vein, and on the left the common carotid and subclavian arteries, with the vagus between them, the phrenic and cardiac nerves, the trunk of the sympathetic, the longi colli muscles, and the superior intercostal arteries and first dorsal nerves.

Auscultation and percussion.—Before going into any details of structure it would seem advisable to point out the relations of the contents of the thorax to the walls of the chest—such, in fact, as relate to the auscul-

tation or percussion of the lungs, heart, and great vessels. As, however, these matters are to be found in works specially devoted to the subject, it is proposed merely to point out the chief anatomical bearings of the contained viscera.

Position of the lungs with regard to the surface.—Presuming the body to be normal, their position with regard to the thoracic walls is as follows: The *apices*

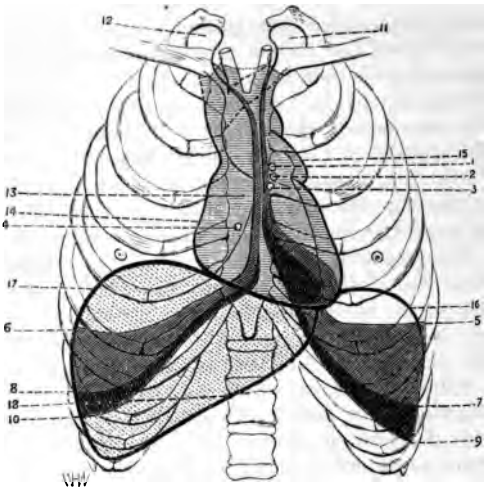


Fig. 20.—Diagram of the relations of the Thoracic Viscera to the Walls of the Chest.

1, situation of pulmonary orifice; 2, left auriculo-ventricular orifice; 3, orifice of aorta; 4, right auriculo-ventricular orifice; 5, limit of the anterior and inferior border of left lung in complete expiration; 6, ditto of right lung; 7, limit of left lung in inspiration; 8, ditto of right lung in inspiration; 9, limit of pleura; 10, ditto; 11, superior cul-de-sac of left lung; 12, ditto of right lung; 13, right auricle; 14, right auricular appendage; 15, left auricle; 16, limit of diaphragm in complete expiration; 17, ditto, ditto; 18, ditto, ditto, in complete inspiration.

lie beneath the scalenus anticus muscle and the subclavian artery, separated by the œsophagus, trachea

l anterior portion of the bodies of the first and ond dorsal vertebræ. The *bases* of each are sepa-ed from the abdominal viscera by the diaphragm, t of the right being considerably hollowed out by bulging upwards of the liver, as far up in the thorax the fifth rib; that of the left is hollowed out to a degree by the projection of the stomach, spleen, l left lobe of liver.

The inner margin of the right lung passes vertically wn the middle of the sternum, with a slight incli-ion to the same side, as far as the sterno-xiphoid iculation.

The inner margin of the left lung lies parallel with t of the right, about as far as to the fourth costal tilage, where it passes outwards along this cartilage a short distance, and then descends obliquely wnwards and backwards, a little internal to the ple, nearly as far as the seventh rib.

Position of the heart with regard to the surface.—The rt lies obliquely, and during expiration is nearly rizontal, its base being to the right and apex to the t side. The base corresponds to the interval between fifth and eighth dorsal vertebræ, and its apex to a le below the left fifth rib, to the left of its junction th its cartilage, while the *impulse* is to be felt in the erspace between the cartilages of the fifth and sixth s, internal to the nipple. Its upper border corre-onds to a line on a level with the upper borders of e third costal cartilages, and its lower border to a e extending between the articulation of the ensiform th the costal cartilage on the right side, to the sition of the apex. Hence, for auscultation of the se, the spot is the upper border of the third costal rtilage, and for the apex, a point about two inches low the nipple, and one inch towards the middle ne of the body.

Position of the great vessels with regard to the surface. —The *right auriculo-ventricular* opening is behind the entre *of the sternum,* on a line with the lower margin

of the articulation of the cartilage of the fourth rib with it. The *left auriculo-ventricular* opening is about three-quarters of an inch lower than the pulmonary orifice.

The *orifice of the pulmonary artery* is on a line with the space between the junction of the second and third costal cartilages with the sternum, being to the left and close to that bone.

The *orifice of the aorta* is at the commencement of the ascending portion of the arch, and is on a line with the junction of the third costal cartilage of the left side with the sternum. The *arch* attains the level of the upper border of the second costal cartilage of the right side at its junction with the sternum. (*Note.*—These relations vary slightly in the works of some authors, but those mentioned above will be found correct for practical purposes.)

WALLS OF THORAX.

The region of the walls of the thorax may be conveniently described surgically, as *sternal*, *costal*, *diaphragmatic*, and *spinal*.

The *sternal* region consists of the sternum itself, the chondro-sternal articulations, and of the structures which immediately cover them—viz, integument, subcutaneous cellular tissue, aponeurosis of pectoralis major, sterno-mastoid, rectus abdominis, and occasionally fibres of the rectus sternalis muscles.

It is surgically of importance, as being the seat of fractures, of dislocations of the clavicle from it, of necrosis and caries, or of gummata The mechanism of the sterno-clavicular articulation, which possesses an interarticular fibro-cartilage and two synovial membranes, allows of motion in almost all directions, and largely assists in the free play of the shoulder. The peculiarity in the construction and the curved form of the clavicle, serve to break the effect of shocks or blows upon the *shoulder* or upper limb. On the right side the sterno-

clavicular articulation is immediately in front of the innominate artery and subclavian vein, whilst on the *left* it is in relation with the left subclavian vein and the interspace between the left common carotid and subclavian arteries; the inter-clavicular space lies immediately in front of the trachea. Posteriorly and below, the sternum is covered by the triangularis sterni muscles, and laterally is in relation with the internal mammary vessels. The sternum is liable to fractures, and dislocations from it of the clavicle—an accident which may occur in any direction but downwards, owing to its close relation with the cartilage of the first rib (*vide* "Region of Clavicle").

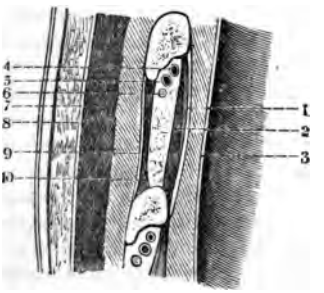


Fig. 21.—Section of sixth Right Intercostal Space, at the junction of the anterior and posterior thirds.

1, aponeurosis covering the internal intercostal muscle; 2, internal intercostal muscle; 3, pleura; 4, intercostal vein; 5, intercostal artery; 6, intercostal nerve; 7, serratus magnus; 8, its aponeurosis; 9, aponeurosis covering external intercostal muscle; 10, external intercostal muscle.

The costal region, which is bounded anteriorly by the sternum, laterally by the sides of the bodies of the ribs, and inferiorly by the diaphragm, presents several points of surgical importance, since it contains the mammary gland, the ribs, and the intercostal spaces. It is covered in anteriorly and posteriorly above by structures *belonging to* the region of the upper

extremity, in front by the greater and lesser pector muscles with their aponeuroses, and behind by tl scapula and the muscles attached to it and betwe the external borders of the scapular and pector muscles, the ribs and the humerus is a special region the axilla.

The ribs.—The direction of the ribs is oblique fr above downwards, and from behind forwards, so th their posterior extremity is considerably higher th the anterior, and a knowledge of the relation of the ri to a horizontal plane passing through the body is oft of use—thus, the first in front corresponds with t fourth behind, the second to the sixth, the third to t seventh, the fourth to the eighth, the fifth to the nint the sixth to the tenth, the seventh to the elevent Owing to the nature of the articulation of the ri with the sternum, the position of fracture may readily made out by percussing the latter bone.

The close neighbourhood of the ribs to the lun and pleura, liver and diaphragm, renders fractures l direct violence often very serious from puncture these structures by the fragments. In indirect violen the rib is broken, as a rule, near the angle, and woun of the intercostal arteries are rare; these vess are, from their position, difficult to secure.

The *intercostal spaces* vary considerably in exten thus they are wider during inspiration; the m remarkable variation in the interspace is at its midd as here, during expiration, the ribs occasionally a proximate so closely that their edges are in absol contact.

The operation of *paracentesis thoracis* or tappi the thorax, in pleurisy, emphysema, or the pointi of an hepatic abscess, is usually performed betw the fifth and sixth ribs, just behind their middle, a *never* behind the angle, because of the size of the int costal arteries at this point, and moreover on accou of the thickness of the layers of muscle. Some pre *a point situated* an inch or more below the angle of t

apula, between the seventh and eighth, or eighth and inth ribs, the instrument being passed just above the *pper* border of the rib, so that the intercostal vessels ay be avoided. On the right side, it is advised to uncture through an interspace higher, on account of he position of the liver and diaphragm on that ide.

Each intercostal artery is accompanied by a vein and erve, the nerve being superior to the artery in the pper intercostal spaces, but below it after the fourth r sixth space. They are protected from pressure, whilst the intercostal muscles are acting, by being enclosed in tendinous bands which are attached to the ribs.

The internal mammary artery belongs properly to the cavity of the chest, lying on the left side in the anterior mediastinum, whilst on the right it is so overlapped by the lung as to be excluded from the space. It lies behind the cartilages of the ribs and the sternum, upon the pleura, and at a short distance from the margin of the sternum. It is given off from the subclavian opposite the vertebral, and passes into the thorax in relation with the phrenic nerve, which crosses it anteriorly and then descends internal to it. Two veins, which usually unite to form a common trunk, accompany it. In the upper part of the chest it is covered in by the costal cartilages and internal intercostals, whilst below it lies between the triangularis sterni and the pleura. Its chief inosculating branches are given off at the interval between the sixth and seventh cartilages, they are *musculo-phrenic* and *superior epigastric.*

Wounds of this vessel, especially if situated where it has any bulk, *i.e.*, between the first and seventh ribs, are serious. It can be *tied* easily in the *first three* intercostal spaces, by making an oblique incision about two inches long from without inwards, and at about three or four lines from the border of the sternum, and *the structures divided in reaching* it are—

integument, cellular tissue, origin of pectoralis ma internal intercostal muscle. Owing to its free ana moses, of course both ends of the wounded ve require ligature.

MAMMARY REGION.

This region presents for examination the skin, subcutaneous layer of fat, the mammary gland it a cellular layer, the aponeurosis of the pectoralis m the pectoralis major itself, the ribs, and interc spaces.

The skin varies in thickness according to its loca excepting over the nipple and areola it presents peculiarity. The areola is pink in virgins, and bec brown during and after childbirth; it contains twenty or thirty tubercles formed by groups sebaceous follicles; whilst the skin which cover gland is very freely moveable over it, the skin of areola is very adherent and immoveable, and the no fat beneath it.

The subcutaneous fatty layer gives the characte form to the breast, and sends processes betwee lobules of the gland.

The mammary gland is situated in front of the toralis major, towards the lateral aspect of the r of the chest, and corresponds to the interval bet the third and seventh ribs (the *male* nipple lies o fourth rib). It is a racemose gland, and is intin associated with the generative functions. It is posed of a certain number of independent lobe lobules of which open into the lactiferous ducts, uniting form larger ones, terminating in an exc duct; these ducts are generally from fifteen to t in number, and converge towards the areola, and be the nipple become dilated into sinuses, before p ting its summit by separate orifices. A large n of muscular fibres exist in the nipple, to which *its erectile* property.

The cellulo-fatty layer beneath the gland separates it from the aponeurosis of the pectoralis major, and gives it its peculiar mobility. It is occasionally the seat of abscess known as retro-mammary; the pus usually points at the anterior fold of the axilla.

The breast is freely supplied with vessels, the arteries being derived from the internal mammary, the axillary, and the intercostals; the veins are both superficial and deep—the superficial are seen beneath the subcutaneous cellular tissue and are very much distended during pregnancy, whilst the deeper ones follow the course generally of the arteries. An anastomotic circle of veins is seen around the base of the nipple. The lymphatics are also arranged as superficial and deep: the former are immediately beneath the integument and pass into the axillary glands; the latter accompany the galactiferous tubes, and pass into the cellular tissue beneath the gland, also to join the glands in the axilla and the intra-thoracic ganglia. The nerves are derived from the intercostals.

The breast is the seat of many forms of tumours which necessitate its removal, and its great vascularity may give rise to severe hæmorrhage during such operations; it is advisable therefore in such cases to make the *inferior* incision first, to avoid, if possible, any complication, owing to the parts being obscured by blood.

Mammary abscesses ought to be opened *vertically* (to avoid "pocketing" and the formation of sinuses), freely and deeply, to insure the exit of all matter. Moreover, these incisions should, if possible, be made parallel to the course of the galactiferous ducts, if near the nipple, in order to avoid cutting across them.

The diaphragmatic region, constituting the floor of the thorax, is formed by the diaphragm which constitutes the septum between the thoracic and abdominal viscera, and is the muscle of normal respiration. Its height, *or the amount of* encroachment upon the thorax

during ordinary respiration, depends in some m upon the amount of distension and the size of abdominal viscera in immediate relation with it- the stomach, intestines, and the liver. During *n expiration* the right arch ascends to the level *fifth* rib. *Forced expiration* brings the right a the muscle—that above the liver—to a level wit fourth costal cartilage in front, with the fifth, and seventh ribs at the side, and with the eigh behind. The left arch is lower than the right l ribs. During *forced inspiration* the muscle de to the level of a line extending from the en cartilage to the level of the tenth rib.

The under surface of the diaphragm is perf by three large foramina:—(1) The aortic, between the pillars of the muscle and spinal c transmits the aorta, the thoracic duct, and th azygos major. (2) The caval, quadrilateral in and incapable of constriction, transmits the i vena cava. (3) The œsophageal, elliptiform capable of constriction, transmits the œsop also the vagi nerves, the left being in fron either side of the attachment of the diaphr the xiphoid cartilage is a space where the m tissue is wanting, so that between the abdominal and that of the anterior mediastinum there is munication, filled in by a little cellular through which pass some lymphatics from th and occasionally a diaphragmatic hernia. (T tions of the pleuræ and peritoneum to the dia will be considered later on.)

Collections of pus forming in the thoracic may find their way through these spaces; m as the diaphragm separates the right lung fr liver, abscesses forming in this latter viscus ma be discharged by the bronchi or into the cavity.

Penetrating wounds of the diaphragm a *serious, partly* on account of hæmorrhage, and

from the fact that the viscera, both of the thoracic and abdominal cavities, may be implicated; and partly on account of the intimate connexion with it of large serous cavities, the pleuræ, the peritoneum, and the pericardium.

Occasionally *paralysis* of the diaphragm occurs with ascites, or may be owing to a wound in the neck or spinal column, implicating the phrenic nerve.

An approximation of the course taken by a bullet or a weapon penetrating the walls of the thorax from its anterior or lateral aspects, may be gathered from the following facts:—That the *heart* would be reached by a wound traversing the chest at right angles, above the sixth rib, and that its apex lies about an inch and a half from the surface. Wounds in the mesial line would involve the heart and great vessels, whilst more laterally they would implicate the lungs; the position of the trunk and branches of the internal mammary artery renders penetrating wounds of the intercostal spaces near the sternum very serious.

A wound penetrating the sternum, on a line with the nipples, and striking upon the vertebra at right angles with the axis of the body, would traverse three cavities of the heart, two ventricles, and the left auricle.

If an instrument traversed any of the lower intercostal spaces during inspiration, it would wound the base of the lung, the diaphragm, and corresponding abdominal viscera, but during expiration would avoid the lung.

Spinal region of thorax.—The posterior wall of the thorax is formed by the dorsal spine and its coverings, and is represented by a region bounded superiorly by the last cervical, and inferiorly by the first lumbar vertebra, and laterally by the angles of the ribs.

The integument is very thick and dense, and contains a quantity of sebaceous follicles; the subcutaneous cellular tissue is intimately united to the spinous processes *of the dorsal vertebræ* (which can be plainly felt

throughout the region), thus preventing fluid infiltrati
or pus appearing superficially, except along the sides
these processes. The dorsal aponeurosis invests t
anterior and posterior surfaces of the trapezius a
latissimus dorsi, uniting superiorly with the cervic
and inferiorly with the lumbar aponeurosis, splitting
enclose the serrati postici; it is attached to the s
nous processes of the dorsal vertebræ and tubercles
the ribs, enclosing all the muscles of the back, a
separating the superficial from the deep layer. T
first layer of muscles consists of the lower part of t
trapezius and the latissimus dorsi, the former ov
lapping the latter. Beneath these muscles lie t
rhomboidei and serrati postici. The deep layer consi
of the sacro-lumbalis internally with its accesso
muscles, and the longissimus dorsi externally also wi
its accessory muscles; between them superiorly, t
lower portions of the splenius colli, complexus, a
transversalis colli; deepest of all, the transverso-spinal
and levatores costarum.

A small triangular space uncovered by muscle exis
at the point where the trapezius and latissimus do
diverge. The space is bounded by the two muscles ju
named towards the spine, whilst externally it is co
pleted by the inferior angle and vertical border of t
scapula. From the fact of its being uncovered
muscle it is available for auscultation.

The *vessels* met with are dorsal branches from t
intercostals and the posterior scapular, and the *nerv*
are the dorsal branches of the spinal, with some fe
branches from the cervical plexus and spinal acce
sory.

Vertebral column in the dorsal region.—With r
gard to the skeleton of this region, the arrangement
the dorsal vertebræ renders simple dislocation almo
impossible, and when displacement does occur it woul
seem to be invariably associated with fracture of so
portion of the spinal column. The spinous processe
from their position, are often fractured.

The dorsal spine is very often the seat of caries, or disease of the intervertebral substances, inducing angular curvature and paralysis of the lower limbs from pressure on the cord.

In abscesses connected with caries of the transverse processes, or laminæ of the dorsal vertebræ, the pus, in consequence of the strong fascial lamina between the superficial and deep muscles, instead of passing towards the surface, gravitates into the inferior portion of the region, and occasionally extends into the axilla.

When the disease consists in caries of the bodies of the vertebræ and abscesses form, the course taken by the pus will depend upon the part of the spine which is the seat of disease; it generally escapes between the pillars of the diaphragm, and passes beneath the fascia, along the side of the aorta and iliac arteries, pointing in the abdominal parietes, *above* Poupart's ligament. If the abscess depends upon disease of the lower dorsal vertebræ, the pus is directed forwards by the sheath of the psoas muscle, and points *below* Poupart's ligament, in the front of the thigh and external to the vessels. The pus sometimes passes backwards, forming dorsal abscess. If it gets into the subperitoneal areolar tissue in the pelvis, it may find its way into the perineum by the side of the rectum, or pass out of the great sciatic notch, and appear in the region of the great trochanter.

Injuries to the cord in the dorsal region, if below the second dorsal vertebra, do not affect the upper extremity, but the respiration is greatly affected, owing to implication of the nerves supplying the intercostals and abdominal muscles; moreover, there is paralysis of all the parts supplied by the nerves below the seat of injury.

CAVITY OF THE THORAX.

As this region can scarcely be considered as with the province of *surgical* anatomy, at all events in limited a work as the present, it is proposed the fore to allude to it as shortly as possible. Its practi bearings to the surgeon seem rather to depend up the relations of the contents to the parietes, which ha been already discussed, both as far as physical diagnc and injury are concerned; and considerations w respect to aneurism of the aorta or its great trunks subjects rather for systematic surgery. Since operat proceedings on the œsophagus, trachea, or great ves are instituted in the neck, the chief anatomical beari of these structures will be found described in the cha on the Surgical Anatomy of the Neck.

The cavity of the thorax is most conveniently scribed for reference as divisible into two ple cavities, separated in the lower four-fifths of the ch by the three mediastiana, and in the upper fifth by great vessels springing from the arch of the aort region called by Professor Wood, the *cervico-thorc* The posterior wall of this division, he makes the tl upper dorsal vertebræ and their intervertebral substan and the intervertebral substance between the third fourth the anterior—the manubrium sterni, and u fourth or fifth of the anterior mediastinum; on ei side the apices of the lungs and pleuræ.

The *anterior mediastinum* is bounded as follow Anteriorly, by the sternum and left costal cartila posteriorly, by the pericardium, for the lower th fourths or four-fifths, and for the rest, by the cer thoracic region; laterally, by the pleura. The *mi mediastinum* contains the heart and ascending por of the aorta and arch, phrenic nerves and vessels, is limited behind by the fibrous pericardium and the literated ductus arteriosus.* The *posterior mediasti*

* *Vide* Professor Wood, F.R.S., on Relations of A "*Journal* of Anatomy and Physiology," vol. iii.

ited above by the left portion of the arch,
by the lesser muscle of the diaphragm; laterally,
cavities, roots of lungs, and ligamenta lata pul-
i.

ontains the bifurcation of the trachea and the
i, vagi, œsophagus, hinder part of root of lung,
urrent laryngeal nerve of left side, descending
azygos major vein, thoracic duct, and great
mic nerves.

CHAPTER IV.

SURGICAL ANATOMY OF THE UPPER EXTRI

REGION OF THE SHOULDER.

Surface markings.—The convexity of the s is due to the deltoid muscle, and the globular l the humerus. The bony processes, the coracoi mion, spine of scapula, globular head of humer the entire extent of the clavicle, can be readi and their exact relation with regard to each other be noticed and compared, and their respectiv ings with the other bony prominences of the extremity carefully studied, both at rest and in The precise relations of these *surface* markings the utmost importance in the diagnosis of f dislocation, or other injury to the shoulder-joi moreover, they serve as guides for the direc the knife in amputations or excisions. Wh arm hangs along the side with the palm turn wards, externally, the acromion, epicondyl styloid process of radius corresponds, and int the head of humerus, epitrochlea, and styloid of ulna.

Anterior and lateral aspects of the shoulder.- riorly, immediately below the clavicle, is a fc which the pulsations of the first part of the a artery can be felt, and which hollow may be obli by the presence of axillary tumours or disloca the humerus forwards.

Externally, the roundness of the shoulder is

the deltoid muscle, beneath which, and below the
hanging process of the acromion, can be felt the
ular head of the humerus. This portion of the
e is sometimes very large in proportion to the
culation, and might be mistaken for a displace-
it. In any dislocation, however, the rotundity of
shoulder gives place to a characteristic flattening;
there is impairment of the movements of the joint.
ng the anterior border of the deltoid is a groove
veen it and the upper fibres of the pectoralis
or, in which lie the cephalic vein and a branch of
acromio-thoracic artery. The skin of this region
ery thick, and glides easily over the underlying
ues, owing to the presence of bursæ, which are
me individuals more or less developed, according
ie use made of the shoulder by their occupation or
k—thus, by carrying a ladder or a hod of mortar,

CLAVICULAR REGION.

he scapulo-clavicular articulation, often distinct
ugh the slight prominence of the clavicle upon the
mion, forms the tip of the shoulder.
his elevation of the external extremity of the
icle, if very much marked, may be mistaken for
slocation.
o the upper border of the clavicle is seen the attach-
t along its sternal portion of the outer fibres of
sterno-cleido-mastoid, and along its acromial portion
anterior fibres of the trapezius.
elow are the attachments of the pectoralis major
nally, and externally the deltoid.
he *clavicle* can be felt in its whole extent, owing
s subcutaneous position, and from being so exposed
able to fracture. Again, its structure, its curves,
ch intensify the shocks of indirect violence, and
want of support posteriorly, all contribute towards
frequency of the accident.

If this fracture takes place at its centre, the d placement of the outer fragment downwards, f wards, and inwards, is due to the weight of t arm, and to the action of the deltoid, pector major, and subclavius. The inner fragment is oc sionally tilted upwards, but only when the clavicu fibres of the sterno-cleido-mastoid are in action, as rotation of the neck, the strong ligamentous atta ment to the rib (costo-clavicular), and perhaps t clavicular fibres of the pectoralis major, retaining it place. The slightness of the displacement on fract of the acromial and sternal extremities is also due their strong ligamentous attachment. The clavicle separated from the upper part of the axilla and contents by the subclavius muscle and its aponeuros behind its sternal extremity is the junction of internal jugular vein and subclavian vein runn closely along it; behind its upper border are supra-scapular vessels, which are liable to be inju in fracture of the bone or operations upon it.

The internal extremity of the clavicle articulates w the sternum by a saddle-shaped joint, possessing inter-articular fibro-cartilage, attached above to clavicle, and below to the sternum and two syno membranes, the office of the cartilage being to br shock between the two surfaces. Moreover, this tremity of the collar bone articulates with the first Notwithstanding the powerful ligaments between tl points, the clavicle is liable to dislocation anterio posteriorly, and superiorly.

With regard to the acromio-clavicular articulatio possesses very slight movement, but is often the of dislocation, which occurs after a severe fall on shoulder, the supra-acromial form being the most quent, and, if complete, the coraco-clavicular ligam are generally torn.

It is worth recollecting that the inter-articular s is situated exactly in the course of a vertical l *passing* through the middle of the anterior aspec

the upper arm; this is useful in diagnosing the nature of injuries affecting the shoulder.

External aspect of the shoulder, or deltoid region.—The deltoid muscle forms the external boundary of the region of the shoulder. The subcutaneous tissue contains the terminal twigs of the acromial branches of the descending clavicular nerves, and of the cutaneous

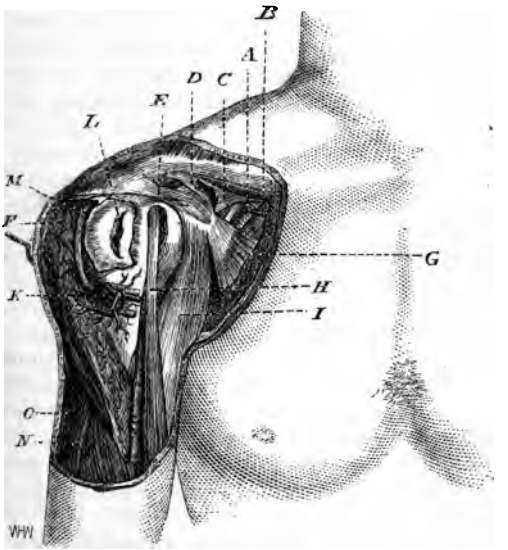


Fig. 22.

A, axillary artery; B, axillary vein; C, costo-coracoid membrane; D, coracoid process; E, coraco-acromial ligament; F, deltoid cut and pulled back; G, pectoralis minor; H, long head of biceps; I, short head of biceps and coraco-brachialis; K, circumflex vessels and nerve; L, head of humerus seen through capsule, upon which is a portion of the bursa between it and the deltoid; M, posterior portion of this bursa between the deltoid and scapular muscles; N, brachialis anticus; O, triceps.

branches of the circumflex nerve and artery. The aponeurosis *of the deltoid* completely covers the

muscle, and is continuous with that of the upper
and axilla, sending down septa between the bun
of the muscular fibres, and passing beneath it, is
tinuous with the deep fascia. The deltoid it
arising from the outer half of the clavicle and
lower border of the spine of the scapula, after
convergence and interlacement of its fibres, is inse
into the roughened surface on the outer aspect of
humerus.

Immediately beneath this muscle is a large bu
often multilocular, which lies between it and the
vex head of the humerus and the acromion proc
the insertions of the supra- and infra-spinatus,
teres minor muscles into the greater tuberosity,
passing round the surgical neck, the posterior cir
flex vessels and circumflex nerve; the bicipital gr
in which lie the long head of the biceps and
anterior circumflex artery; the coracoid process,
the short head of the biceps and coraco-brac
attached to it, a quantity of loose cellular ti
and the capsular ligament. Severe blows upon
shoulder frequently cause effusion into the
above named, and render diagnosis of the precise ir
extremely difficult, and suppuration in its cavity
be mistaken for disease of the articulation. In the
of effusion of blood into the cavity, the post
border of the axilla will become discoloured a
days after the injury.

Posterior aspect of the shoulder, or scapular regi
The spine of the scapula is seen directly beneath the
as a furrow in muscular persons, and as a prom
ridge in emaciated subjects, terminating in its
acromion process, which overhangs the articul
Above and below the spine are the supra- and
spinous fossæ, filled in by muscle, the superior
than the inferior, owing to the attachment of the
zius along the upper border of the spine. The in
angle of the scapula is just beneath the su
having sometimes fibres of the latissimus

ached to it, which muscle, as it sweeps forward wards the arm, forms the posterior border of the illa; occasionally the scapula becomes dislocated er the upper edge of this muscle, or rather the uscle slips beneath the scapula.

The supra-spinous fossa contains the supra-spinatus uscle, between which and the bone lie the supra-apular vessels and nerve, the nerve passing below e supra-scapular ligament and the vessels over it; ese vessels, after supplying the supra-spinatus muscle d the nerve, wind round the root of the acromion to the infra-spinous fossa, and there the important osculation takes place between the dorsalis scapulæ d posterior scapular, which becomes greatly deve-ped after ligature of the subclavian in the third part its course, playing a chief part in the maintenance the collateral circulation for the supply of the arm.

i front of the scapula, between it and the ribs, is e subscapularis, a multi-penniform muscle, the full velopment of which gives such an appearance of pth to the thorax in muscular persons. Beneath the ndons of the muscles inserted into the greater and sser tuberosities are large bursæ, occasionally commu-icating with that beneath the deltoid, and with the novial sac of the shoulder-joint; inflammation or ppuration of which may be mistaken for glandular flammation or for axillary aneurism.

The bursa between the latissimus and the scapula ometimes developes enormously, passing below the wer border of that bone, and extending upwards eneath the subscapular muscle, or between it and the one. A point of value in diagnosis of tumours of his kind is to put the latissimus dorsi in action pposing it, by placing the back of the hand in the mall of the back.*

* In a case in the author's practice an enlarged bursa in this egion, had been supposed to be a rapidly-growing neoplasia, nd this dorsal rotation *of the arm* was invaluable in establishing he diagnosis.

Articulation of the shoulder-joint.—The ellipsoi articular extremity of the humerus is very large comparison with the glenoid cavity, which is ovoid shape, larger below than above; and it is surgica of importance to note that not only are the articu surfaces of the humerus and scapula here in conta but that the head of the bone is in immediate relati with the arch formed by the coracoid and acromi processes and the coraco-acromial ligaments—an proximation which is due to the action of the delto in *atrophy* of which muscle there is a considera interspace between these points. The capsule of t

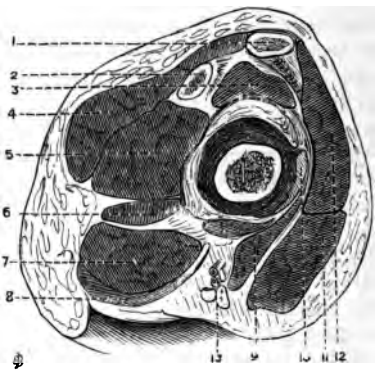


Fig. 23.—Transverse Section through Right Shoulder-joint, showing structures in contact with it.

1, clavicle; 2, acromion; 3, supra-spinatus: 4, trapezius: 5, inf spinatus; 6, teres minor; 7, teres major; 8, latissimus do 9, coraco-brachialis and short head of biceps; 10, tendon subscapularis blended with the capsular ligament; 11, pe ralis major; 12, deltoid; 13, axillary vessels and nerves.

joint is materially strengthened by fibrous expans from the tendons of those muscles which are in *im diate* contact with the articulation—viz., the su and infra-spinati, teres minor, subscapularis, and l *head of* biceps and triceps, and by bands passing fi

he coracoid process. The synovial membrane lining he capsule is prolonged beneath the subscapularis nuscle, and into the bicipital groove.

The movements of which the humerus is capable in he glenoid cavity are very varied, and, with a view to tudying the action of the muscles in dislocation and racture of this bone, and in their diagnosis, may be lassified as follows: The humerus is *raised* by the deltoid, supra-spinatus, long head of biceps, and coraco-brachialis; *depressed* by the pectoralis major, latissimus dorsi, teres major, and subscapularis; *brought forward* by the pectoralis major, anterior fibres of deltoid, coraco-brachialis, and short head of biceps; *drawn backwards* by the latissimus dorsi, teres major, long head of triceps, posterior fibres of deltoid, supra-spinatus, and teres minor; *rotated inwards* by subscapularis, teres major, latissimus dorsi, pectoralis major, and anterior fibres of deltoid; *rotated outwards* by the infra-spinatus, teres minor, coraco-brachialis, and posterior fibres of deltoid.

The great power of all these muscles upon this joint, which owes its great extent of motion to the shallow glenoid cavity and large head of humerus, and the laxity of its capsule, favours dislocation under certain circumstances; and were it not for the bony arch formed by the coracoid and acromion processes, and the ligament between them, the long head of the biceps passing through the capsule over the head of the bone and blending with the glenoid ligament, and the mobility of the scapula, such accidents would be still more frequent.

The anatomical position of the head of the humerus with regard to the neighbouring bony structures after its dislocation may be generalized thus—*sub-glenoid, sub-clavicular, sub-coracoid, sub-spinous.*

In the condition termed *sub-glenoid*, the head of the humerus rests on the inferior border of the scapula, below the glenoid cavity, between the subscapularis and *long head of triceps*; and the peculiar numbness

in the hand and arm, and frequent coldne
œdema in the limb, are due to pressure upo
brachial plexus and axillary vessels. In th
clavicular variety, the head of the bone lies bel
clavicle, internal to the coracoid process, up
second and third ribs, and beneath the pector
cles. In the *sub-coracoid*, the head of the bo
deeply in the upper and inner part of the axilla,
the coraco-brachialis and pectoralis muscles.
sub-spinous form, the head of the bone lies behi
glenoid cavity, below the spine, and betwe
infra-spinatus and teres minor muscles. Thes
be regarded as the *complete* forms, which
course, liable to modifications.

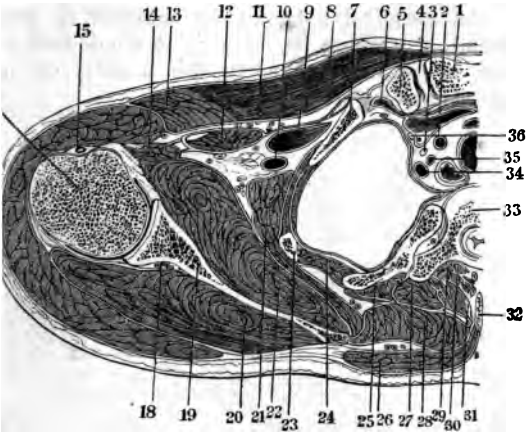
That portion of the bone belonging to the
of the shoulder—that is to say, as low down
insertion of the deltoid—is liable to fracture
anatomical neck, which is *intra-capsular*, and
ture of the surgical neck, which is *extra-ca*
In the former there is little or no displacement
muscular action; in the latter case the uppe
ment is abducted slightly by the supra- and
spinatus, teres minor, and subscapularis; the
fragment is drawn inwards by the pectoralis
latissimus dorsi, and teres major, whilst the
draws it obliquely from the side of the body.

In cases of fracture of the anatomical neck
separation, it may necrose, owing to there be
means of vascular supply to the fragment, and
it may be inferred that impaction has occurre
any rate, whatever amount of repair does take
is due to the lower portion of the shaft of the
In impacted fracture the axis of the bone is ob
altered, and there is a slight cavity beneat
acromion, owing to shortening. The upper ar
extremity unites with the shaft at about the *tw*
year.

The upper epiphysis is sometimes separat
infants, in consequence of the carelessness of

ting them suddenly up by the arm, giving rise to serious mischief.

ıe accurate diagnosis of the nature of the lesion injury to the shoulder-joint is often very difficult, attention should be given to the following points.



24.—Section through head of Humerus, and passing through the Trunk at the level of the third Dorsal Vertebra. (One-fourth.)

ernum; 2, left carotid artery; 3, vagus nerve; 4, inter-acular fibro-cartilage; 5, clavicle; 6, sterno-hyoid muscle; clavicle; 8, pectoralis major; 9, axillary vein; 10, axillary ery; 11, fascia behind pectoralis major; 12, pectoralis nor; 13, clavicular fibres of pectoralis major; 14, coraco-achialis and biceps; 15, long tendon of biceps; 16, head of merus; 17, deltoid; 18, transverse scapular vessels; 19, sca-la; 20, infra-spinatus muscle; 21, serratus magnus; 22, sub-spularis; 23, second rib; 24, internal intercostal muscle; 25, ator costæ; 26, trapezius; 27, longissimus dorsi; 28, rhom-ideus major; 29, biventer cervicis; 30, semi-spinalis and ltifidus spinæ; 31, splenius colli; 32, spinous process of second rsal vertebra; 33, third dorsal vertebra; 34, subclavian vein; vertebral artery; 36, phrenic nerve. (The humerus in this tance is rotated *inwards*.)

t of all, it must be seen whether the head of ierus *is in its place*; if fracture be suggested it

must be either in the surgical neck of the hu
or its anatomical neck, the external extremity
clavicle, the acromion, or the coracoid process
neck of the scapula—each of which must be ca
examined in turn. In the absence of either of
conditions, there is probably a contusion or a
In the event of inflammatory mischief, it m
determined whether its locale is in the deltoid
itself, in the bursa beneath this muscle, or
scapulo-humeral articulation itself.

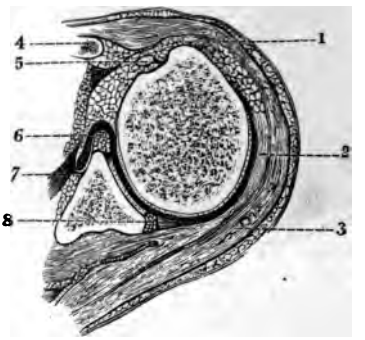


Fig. 25.—Section through Head of Humerus and Glenoid
the arm being rotated *outwards* to its greatest exte
(One-half.)

1, tendon of supra-spinatus; 2, infra-spinatus; 3, deltoid;
coid process; 5, long tendon of biceps; 6, glenoid lig
7, subscapularis; 8, glenoid ligament.

The landmarks already described in the sup
examination of the shoulder are of the greate
portance in the performance of the operations of
tation at the shoulder-joint, and of *excision of th*
of the humerus.

Contents of flaps after disarticulation at sh
joint by transfixion.—The external flap thus fash
should contain—integument, the posterior fibres
deltoid, circumflex vessels and nerve, tendons of

sinus dorsi, teres major, and teres minor; the internal flap—the subscapularis, long head of biceps, coracobrachialis, anterior fibres of deltoid, pectoralis major, axillary vessels and nerves, and integuments.

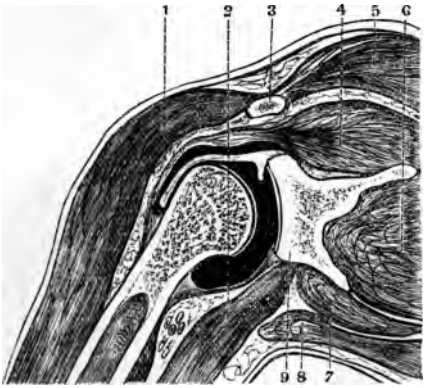


Fig. 26.—Frontal Section of the Shoulder-joint, showing the Capsule distended with fluid. (One-third.)

1, deltoid; 2, triceps; 3, clavicle; 4, supra-spinatus; 5, trapezius; 6, infra-spinatus; 7, teres minor; 8, teres major; 9, scapula.

SURGICAL ANATOMY OF THE AXILLA.

Surface markings and external form.—When the arm lies against the wall of the chest the area of the axillary space becomes confined, and for anatomical considerations ceases to exist; also when the humerus is extended beyond a right angle, the head projects into the space and obliterates its fold, but when the arm is raised to about an angle of 45° and the muscles contract, the depth of the fold of the axilla is most marked.

The *boundaries* of the axilla, which are seen beneath the skin, are—*anteriorly*, the lower margin of the pectoralis major muscle, rounded and muscular, but becoming tendinous as it approaches the humerus;

posteriorly, the lower edge of the latissimus d muscle; *internally*, the chest wall; *externally*, arm. The axillary artery is readily felt along external boundary, and may be here compre against the bone as it lies in the third part o course, and it will be observed that this vessel fol

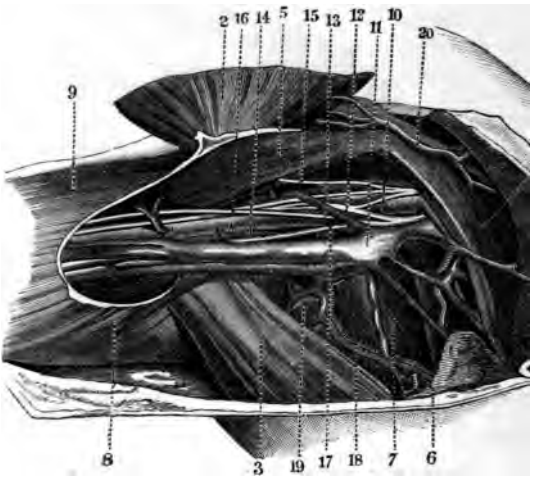


Fig. 27.—Axilla.

1, 2, pectoralis major reflected; 3, teres major and latiss dorsi; 4, pectoralis minor; 6, coraco-brachialis and short of biceps; 6, part of serratus magnus; 7, subscapularis triceps in its fascia; 9, brachialis anticus in its fascia; axillary artery; 11, axillary vein; 12, median nerve; 13, culo-cutaneous nerve; 14, musculo-spiral nerve; 15, nerv coraco-brachialis; 16, musculo-cutaneous nerve; 17, u nerve; 18, subscapular vessels; 19, circumflex vessels; 20, mio-thoracic vessels.

the course of the arm in whatever position it ta The *base* is formed by the integument, which is f provided with hair bulbs and sebaceous follicles.

As the axilla would, in most cases, be attac *surgically* from below, that is, from its base tow

its apex, it will be found to be advisable to describe its relations and contents as they would be met with in this direction.

Topography.—The integument is fine and covered with hair in the adult, and containing a number of sudiparous glands, next the subcutaneous cellular tissue, containing a good deal of reddish fat in its meshes; next, an aponeurosis, which is continuous in front with the sheath of the pectoralis major; behind with that of the latissimus dorsi; externally with the brachial aponeurosis, and internally with that covering the serratus magnus. On removing this aponeurosis the axillary space is opened; a large quantity of loose fat and cellular tissue and a number of lymphatic glands are seen filling up the interspace between the thorax and the arm.

Lying in this cellular tissue, and bridging across from the arm to the chest, will be seen a good many nerves, the intercosto-humeral, which, in some subjects, forms almost a plexus, supplying the skin of the base of the axilla; together with some branches of the axillary artery, the long thoracic and its veins passing downwards and forwards towards the anterior inferior aspect of the space, besides a considerable number of branches to the glands (alar thoracic). On removing this cellular tissue the walls of the axillary space can be made out.

The *internal* or *thoracic* wall, slightly convex, is formed by the first four ribs and their intercostal muscles, and the first five serrations of the serratus magnus, upon which lie the posterior thoracic nerve, the superior thoracic, and long thoracic branches of the axillary artery, with their corresponding veins.

The *external* or *scapulo-humeral* wall, formed by the scapulo-humeral region, is the most important, as on it lie the great vessels and nerves in their fascial envelope; and the fact of the close adherence of these structures to this wall of the axilla is of great value to the surgeon in the extirpation of tumours or opening

of abscesses, which fortunately, as a rule, lie alon the inner wall. On either side of the bicipital groov are inserted the tendons of the pectoralis major an teres major, the latter being internal, and a litt anterior and external is the tendon of the latissimu dorsi. Lying in this groove and enclosed in a pr longation of the synovial membrane of the joint is th long head of biceps itself; and most internally a seen the conjoined fibres of the coraco-brachialis an short head of biceps, the inner border of the form being the guide to the vessel; the insertion of th tendon of the subscapularis, and origin of the long he of the triceps. Above the tendon of the teres maj the lower portion of the capsule of the joint is visible

The *anterior* wall is formed by the pectoralis maj and minor and their aponeuroses, and the lower bord of the former covered by the integuments constitut its anterior inferior margin. In the *female* this marg is hidden by the mammary gland, which overhangs i The position of this gland is not influenced by th movements of the shoulder upon the trunk, as th cellular membrane between it and the anterior layer the sheath of the pectoralis major permits of the fr motion of the muscle beneath it; but in the case scirrhus, owing to infiltration of the tissues, the mov ments of the pectoral are made with great pain a difficulty. On the posterior surface of these musc are seen the acromio-thoracic vessels and external a internal anterior thoracic nerves.

The *posterior* wall is formed by the teres major a latissimus dorsi muscles below, and by the subscap laris above with their vessels and nerves.

The *apex* of the axilla may be referred to the co coid process, though more correctly to the apertu between the clavicle, upper border of scapula, and fi rib, with their muscular coverings. The cellular tiss of the cavity of the axilla becomes continuous with th of the subclavian region at the apex by enveloping t *vessels that* pass through this interspace.

CONTENTS OF THE AXILLARY SPACE.

The Axillary Fasciæ.

Although the axilla varies greatly in outward form during the different movements of the arm and thorax, and its various compartments become reduced or increased in capacity, the *relations* of its fasciæ are constant; and the vasculo-nervous cord formed by the axillary vessels and plexus is also a constant as regards the arm and chest-wall. The surgeon may have to deal with abscess or growths in this region with an anchylosed shoulder-joint. The axillary space is, after all, inseparable from the cervical region, both with respect to its fasciæ and cellular tissue, and, of course, is surgically continuous; but the result of suppuration may be localized in the armpit.

The pectoralis major is covered by a strong lamina of fascia, which is attached to all the subcutaneous bony eminences, and after assisting in forming the sharp anterior fold of the axilla, where it is very tough, it spreads out as a thinner but perfectly continuous layer, which forms the fascial floor of the axilla, and, covering the latissimus dorsi and teres muscles, passes upwards and backwards, becoming developed into the dense deltoid and scapular aponeuroses, whilst anteriorly and externally it is continuous with the brachial fascia. A deeper layer is given off at the anterior axillary fold, which passes upwards and forms the posterior layer of the sheath of the pectoralis major. The superficial pectoral aponeurosis sends down a process between the pectoralis major and deltoid, which becomes continuous with the costo-coracoid membrane, and supports the cephalic vein and some branches from the acromial axis.

The middle lamina of the deep cervical fascia, after having split to enclose the subclavius, reunites, and is attached to the clavicle, coracoid process, and fascial covering of *the serratus* magnus, forming the costo-

coracoid membrane, which covers in the axillary vessels and nerves and clavi-pectoral triangle. Again dividing it encloses the pectoralis minor; reblending at the lower edge of this muscle, it becomes incorporated with the superior pectoral fascia and the anterior fold of the space, forming the *suspensory ligament of the axilla*, the most important factor in the disposition of abscess, and the existence of which is too frequently ignored or undescribed; hence it completely isolates the vasculo-nervous cord from the anterior compartment of the axilla, its internal border being continuous with the sheath of the pectoralis minor, and its external with the brachial aponeurosis.

The pectoralis minor is enveloped in a zone of loose areolar tissue, which is most favourable for suppuration. Hence the pus may exist between the pectorals, or below the pectoralis minor: in the former case it would "point" at the anterior border of the axillary fold, or in the furrow between the deltoid and pectoralis major; in the latter, the pus being behind, and bound down by the clavi-pectoral fasciæ, would have a tendency to surround the vasculo-nervous cord and ascend into the neck, infiltrating the cellular space, and ultimately find its way into the superior aperture of the thorax, and so into the anterior or posterior mediastinum. There is a great tendency for the pus to find its way beneath the latissimus, and burrow into the subscapular fossa, whence it may involve the articulation of the shoulder. In some instances the pus will extend down as far as the brim of the false pelvis.*

The axillary artery, axillary vein, and brachial plexus form a vasculo-nervous cord, bound together by a dense cellular sheath which is placed on the outer wall of the space, and lying along the inner border of the coraco-brachialis muscle; the pulsations of the artery are felt at the apex (if the pectoralis major i

* Abstract of Clin. Lect. delivered in Charing Cross Hospital by author. 1879. *Med. Times and Gaz.*

relaxed), and at its lower portion, and in thin persons the *cord* of the median nerve is usually seen stretched over it when the arm is raised from the side. The *course* of this vessel is indicated by a line passing through the axilla, drawn from about the centre of the clavicle to the inner border of the coraco-brachialis muscle. It lies in an envelope of nervous cords—the median, musculo-spiral, musculo-cutaneous, ulnar, and internal cutaneous. The axillary vein is very large, and lies internal to and a little in front of the artery, and in ligature of the artery it is seen first, and must be drawn to one side. It is adherent to the cellular tissue and by fascial attachment to the coracoid process, and if wounded is liable to gape considerably, and thus admit air, an accident which has happened in removing axillary tumours.

Relations of axillary artery.—In the *first* part of its course, *i.e.*, between the clavicle and the upper border of the pectoralis minor muscle, it lies beneath the clavicular attachment of the pectoralis major, in a triangle (the *subclavicular*), which is bounded above by the subclavius muscle, below by the pectoralis minor, and internally by the thoracic wall. Immediately beneath the pectoralis major is a dense fascia (the *costo-coracoid membrane*). In *front* of the vessel in this part of its course lie the clavicular portion of pectoralis major, the subclavius muscle, costo-coracoid membrane, and cephalic vein, and the loop from the outer and inner cords, giving off the external and internal anterior thoracic nerve; *externally*, the cords of the brachial plexus; *internally*, the axillary vein; *posteriorly*, the first intercostal muscle, second serration of serratus magnus, and the nerve of Bell.

The *second* part of the course of this vessel lies beneath the crossing of the pectoralis minor, and by dividing the remaining portion of the pectoralis major and the pectoralis minor, the whole extent of the vessel will be exposed.

In *front of the second* portion of the vessel lie the

pectorals and inner head of median nerve; *exter* the external cord of the brachial plexus; *inter* the axillary vein and inner cord of the plexus; *riorly*, the posterior cord of the plexus and the scapularis muscle, separated from it by a ce interval.

The *third* portion of the vessel is beyond the] ralis minor, and between it and the lower border (pectoralis major by which it is covered. In *fro* the third portion of its course lies the pect major; *externally*, the coraco-brachialis, the me and musculo-cutaneous nerves; *internally*, the ı and internal cutaneous nerves and axillary vein; *riorly*, the musculo-spiral and circumflex nerves, the tendons of the latissimus dorsi, teres major subscapularis muscles.

The branches of the axillary artery are usually off in the following order: the *thoracica suprema*, v runs along the upper part of the inner wall *acromio-thoracic*, sending branches to its anterior the *long thoracic*, lost on the thorax and mam gland; the *subscapular*, which descends obliquely the inferior border of the subscapularis, and is d buted to the muscles of the posterior wall, one branch in particular, the *dorsalis scapulæ*, passi the dorsum scapulæ in the triangular interval bet the two teres muscles and long head of triceps *posterior circumflex* passes through the quadril space formed by the two teres muscles, long he triceps, and humerus, and winds round the neck c humerus, supplies the deltoid, and is accompanie the circumflex nerve and veins; the *anterior circu* a small branch, is supplied to the articulation be the coraco-brachialis and biceps, and inosculates the former.

Thus, if the vessel be normal, the acromio-tho and thoracica suprema are given off above the pect minor, the external mammary about opposite the m *of this* muscle, and the dorsalis scapulæ and an

and posterior circumflex at the lower border of the subscapularis muscle.

Besides the large nervous trunks, branches derived from them are met with passing to the muscles covering the several walls of the space. Thus, the anterior wall is supplied by the loop formed round the first part of the artery by the external and internal anterior thoracic nerves, the inner wall by the posterior thoracic, the posterior wall by the subscapular, the outer by the circumflex and musculo-cutaneous.

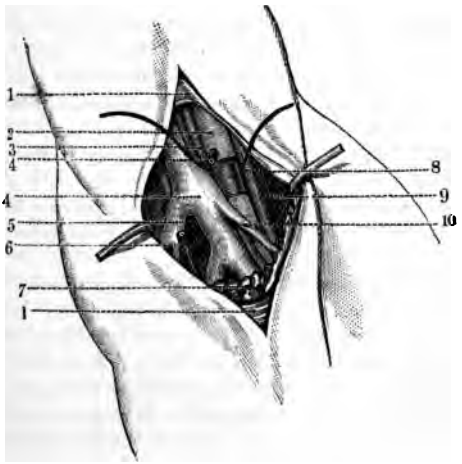


Fig. 28.— Ligature of left Axillary Artery.

1, axillary fascia; 2, axillary artery; 3, internal cutaneous nerve; 4, external thoracic artery (cut); 5, subscapular vein; 6, external thoracic artery (cut); 7, lymphatics; 8, median nerve; 9, coraco-brachialis muscle; 10, external thoracic vein. (The sheath of the artery has been denuded at the point of ligature.)

The *lymphatic glands* are very numerous, and lie, some along the course of the vessels, and some along the lower border of the pectoralis major. These glands receive the *lymphatics* of the upper extremity, back,

and posterior part of neck, the lateral lymphatics of trunk, those of the epigastrium and anterior part thorax, and mammary region.

Ligature of the axillary artery.—The axillary art may be tied in the first part of its course or in the thi

In the first part it is very deep and difficult access, but it may be reached, either by an incis separating the fibres of the pectoralis major a deltoid, or by a semilunar one, extending from a li external to sterno-clavicular joint towards the corac process, taking care to avoid the cephalic vein; n the clavicular fibres of the pectoralis major must divided, the arm adducted, and the pectoralis mi drawn down. The costo-coracoid membrane, which next seen on the stretch, must be opened, the cords the plexus drawn outwards, and the axillary v inwards, when the ligature can be passed from *with outwards.*

This operation is very difficult and dangerous, fr the close relation of the axillary and cephalic vei and the acromio-thoracic vessels.

In the third part the vessel is easily reached.

The arm is to be extended and supinated, in or to throw out the fold of the coraco-brachialis mus the inner border of which is the guide to the arte and an incision of about three inches in length is be made through the integument, rather nearer anterior than the posterior fold of the axilla, the d fascia being scratched through and the basilic axillary vein avoided; the artery is seen lying cros by the median nerve, and having the axillary vein its inner side, and sometimes on it; these structu must be carefully isolated, and the needle passed fr *within, outwards.* Occasionally the vessel divides h up into the brachial and radial, thus complicating operation of ligature. Again, after division, th trunks may reunite by cross branches, and the ci lation continue as freely as before, unless a ligat be applied to each.

On applying a ligature to the axillary artery in its ird part the following hint may be useful: divide the eguments at the junction of the anterior with the o posterior thirds of the fold of the axilla, look for e axillary vein, count two nerves, and next in order the artery.

Collateral circulation after ligature of the axillary.—igature of the axillary artery in the upper part of the rst portion of its course, above the giving off of the romial thoracic, may be regarded as equivalent to gature of the subclavian in the *third part* of its ourse (*vide* "Ligature of Subclavian"). If the vessel e tied below this point, the subscapular inosculat-ig with the supra-scapular and posterior scapular, nd the long thoracic with the internal mammary and ntercostals, are called upon to restore the circulation. f the ligature be applied below the giving off of the ubscapular, the posterior circumflex, anastomosing vith the supra-scapular and acromio-thoracic, and the ubscapular with the superior profunda, form the chief ollateral channels.

Malgaine and Tillaux have both recorded a mus-ular anomaly which would be likely to embarrass the perator; should he encounter it, this is a subapo-eurotic muscular band, which crosses the vessels bliquely, passing from the latissimus dorsi to the pectoralis major, and which might be mistaken for the coraco-brachialis.*

SURGICAL ANATOMY OF THE BRACHIAL REGION.

Surface markings.—This region may be considered as lying between a line drawn round the lower border of the axilla, and another round the arm just above the condyles of the humerus. Its general form is that of a cylinder, flattened internally and externally,

* This slip is considered by Professor Wood to be an imperfect development of the *dorsi-epitrochlear* muscle of the lower animals. (*Vide Wood, Proc. Roy. Soc.*, June 21, 1866.)

convex in front, owing to the swell of the muscle. Along the inner aspect of the bice well-marked groove, extending from the axill bend of the elbow; whilst a shallow groov also on its outer surface, becoming lost at th of insertion of the deltoid; beneath the skin in the internal groove the basilic vein, and to the biceps, the cephalic. The posterior su the brachial region is rounded at about its where the greater mass of the triceps musc and below this point its flattened sharp-edged forms towards its insertion into the olecranc the inner groove lies the brachial artery, wher be felt or seen pulsating, overlapped by th border of the biceps at about its middle, the forming the guide to it throughout its course for its deligation or compression. The surgi siderations affecting this region refer chiefly putation, ligature of its vessel, fractures, a removal of tumours.

Topography.—Beneath the integument th cutaneous cellular tissue, divided into two lam a layer of fat, is first met with, and it is tissue that the superficial veins and lymphatics

The *brachial aponeurosis* completely envelo arm, and is thickest at the back and sides; it tinuous above with that covering the deltoid, a and subclavicular regions, and below with that ing the forearm, and sending processes betwe muscles forms septa, which are attached humerus. The attachment of this aponeurosis evident laterally, where it is inserted into th dyles and condyloid ridges of the humerus, d the region into two distinct compartments, an and a posterior.

The *anterior* contains, successively, the bice mediately beneath which, in the lower half of t is the brachialis anticus, enclosing at the upp of its origin the insertion of the deltoid, and

downwards to its own insertion, covers in the humerus completely between the lateral margin of the anterior and posterior compartments. Behind, and internal to the biceps above, is the coraco-brachialis;

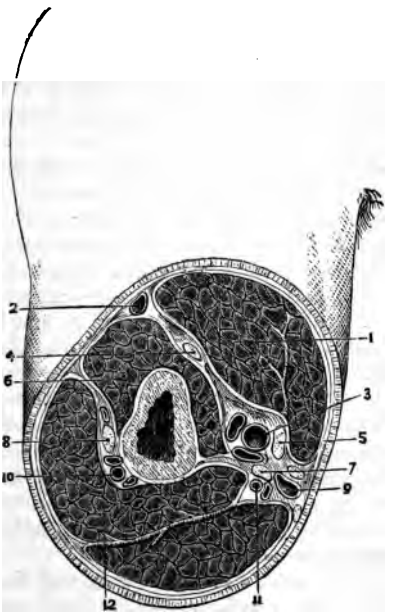


Fig. 29.—A Section through the middle of the Right Upper Arm. 1, biceps; 2, cephalic vein; 3, brachial vessels; 4, musculo-cutaneous nerve; 5, median nerve; 6, brachialis anticus; 7, ulnar nerve; 8, musculo-spiral nerve; 9, basilic vein, with internal cutaneous nerves; 10, superior profunda vessels; 11, inferior profunda vessels; 12, triceps, with fibrous intersection. (Heath.)

below and externally are, the musculo-spiral nerve, the origins of the supinator longus and extensor carpi radialis *longior.*

Lying along the inner border of the biceps is the vasculo-nervous cord, formed by the brachial artery, its veins, and the median, ulnar, external and internal cutaneous nerves; the median accompanies the artery throughout, lying first outside it, then upon it, and lastly internal. In the upper third, this vasculo-nervous cord lies along the inner border of the coraco-brachialis, having the long head of the triceps behind and just on the humerus, against which the vessel is easily compressed; in its lower two-thirds it lies on the brachialis anticus.

The *posterior* aponeurotic compartment contains the triceps, which covers in the entire posterior surface of the humerus and the musculo-spiral nerve before it passes anteriorly, as it lies in the musculo-spiral groove with the superior profunda vessels, before it perforates the septum to pass into the anterior compartment. It also contains the ulnar nerve, which at first lies in the anterior compartment, in contact with the brachial artery above.

This aponeurotic investment presents, moreover, two superficial openings, by means of which collections of pus or blood may become subcutaneous, one above and external, giving passage to the cutaneous branches of the musculo-spiral nerve, and the other on the internal aspect of the arm, giving passage to the basilic vein and internal cutaneous nerve.

A correct knowledge of the relations of the layers of these muscles, their aponeuroses, and the course taken by the main vessel and its branches, determines the contents of the flaps in amputation of the upper arm.

Relations of the brachial artery (above bend of elbow). —Its course is indicated by a line drawn from the junction of the anterior with the posterior two-thirds of the axilla, to the centre of the bend of the elbow. It is accompanied by venæ comites, which frequently interlace and conceal the vessel when cut down upon. In *front* of the vessel is the integument and fasciæ and *the* median nerve; *externally*, median nerve (in upper

half), coraco-brachialis, and biceps; *internally*, internal cutaneous and ulnar nerves, and in lower half the median nerve; *posteriorly*, lie the brachialis anticus, coraco-brachialis, musculo-spiral nerve, and superior profunda vessels, separating the middle and long heads of the triceps.

Ligature in the upper third is performed by making an incision about two inches in length along the inner border of the coraco-brachialis muscles; the subcutaneous tissue and aponeurosis are to be divided, taking care to avoid the basilic vein; then the internal cutaneous and ulnar nerves will be found on the inner side of the artery, the median externally, and a number of venæ comites superficial to, and on each side of it. The needle should be applied from *within, outwards*. Occasionally two arteries are found lying parallel to each other, or placed one over the other, the posterior lying very deep, the result of a high division; under such circumstances it is obvious that it must be determined by pressure whether one or both communicate with the aneurism or wound.

In the middle third the vessel is not so easy to tie as might be imagined from its superficial position; it is beneath a very dense part of the fascia, and is often overlapped by the biceps, which structure is very moveable beneath the integuments. It is reached by an incision along the inner border of this muscle, the forearm being slightly flexed so as to relax the biceps. The median nerve is usually first met with, crossing the vessel; this should be drawn inwards and the biceps outwards, and the venæ comites carefully separated from the trunk before a ligature is applied. In this instance, as in several others, it is advisable to make the incision slightly *oblique* to the real course of the vessel, as room is gained, and also a better view of any deviation from its natural position. The inferior profunda, if large, or the ulnar nerve, may sometimes be mistaken for this vessel.

Branches of the brachial artery.—The superior pro-

funda is given off generally opposite the lower bo of the teres major, and accompanies the musculo-s nerve; the *nutritious* artery enters the nutrient c near the insertion of the coraco-brachialis, and pa downwards towards the elbow-joint; the *inferior funda* accompanies the ulnar nerve; the *anastomo magna* arises on the inner side, about two inches at the elbow-joint, and lies between the brachialis ant and median nerve, crossing the latter, and finally divi into two large branches. In applying a ligature to lower portion of the main trunk, the position of t vessel is of importance, as it is the chief means of ca ing on the collateral circulation.

Collateral circulation. — After ligature *above* origin of the profunda superior, the posterior circ flex and subscapular, anastomosing with the ascend branches of the profunda, carry on the circulation *below*, the superior profunda, inosculating with recurrent branches of the radial, ulnar, and in osseous, would maintain it.

The *action of the muscles* attached to the hume upon the fragments in *fractures* of this bone, generally as follows:—If below the insertion of muscles attached to the bicipital groove, but above insertion of the deltoid, this muscle drags the lo fragment upwards and outwards, whilst the former draw the upper fragment towards the trunk. If be the insertion of the deltoid, the action of the mus depends upon the direction of the fracture; that i say, whether it be oblique or transverse.

Bearing in mind that the period of union of the sl and its superior epiphysis is about the thirteenth y we have an important diagnostic point, in cases of d culty, between fractures immediately above the c dyles, separation of the epiphysis, and dislocation of b radius and ulnar backwards. If the fracture exists, crepitation and ready reduction of the bones to t normal position would distinguish it from dislocati *Again, if* instead of being transverse, the fracture of

shaft be oblique, in a direction from above downwards and forwards, the triceps will draw the lower fragment upwards and backwards; if oblique in a contrary direction, the lower fragment would be drawn upwards and forwards by the brachialis anticus and biceps. Occasionally, however, there is no displacement, in the case of the "screw fracture," or fracture *en V.*, which may take place from violent muscular action, as in throwing a cricket-ball.*

Owing to the attachment of the flexors and extensors of the wrist and fingers to the condyles, unless the forearm be also put up in a bent splint, there is a great liability to ununited fracture, as any movement of the wrist would tend to displace or rotate the lower fragment.

SURGICAL ANATOMY OF THE REGION OF THE ELBOW.

Surface markings.—This region includes the articulation of the elbow-joint, and its immediate relations, and presents for superficial examination four surfaces. In *front* a hollow is formed by the muscles attached to the condyles, within which lies the tendon of the biceps, its margin sharp externally, and flattened internally where its fascia is felt passing to the muscular mass attached to the inner condyle, and below which can be seen or felt the pulsation of the brachial artery; beneath the skin are visible, particularly in thin persons, the superficial veins of the bend of the elbow. On the *outer* side can be felt the external condyle, and the head of the radius; *internally*, the inner condyle; whilst *posteriorly*, nearer the inner than the outer condyle, is the olecranon, with the insertion of the triceps tendon.

The mutual relations of these structures to each other should be carefully examined in every position of the normal arm, in extreme and intermediate flexion and extension, and in pronation and supination of the forearm, and in cases of injury compared with the opposite

* Vide *case in author's* practice. *Lancet*, May 11, 1878.

side. In complete extension, the olecranon is above the level of the condyles ; in semiflexion, on the same

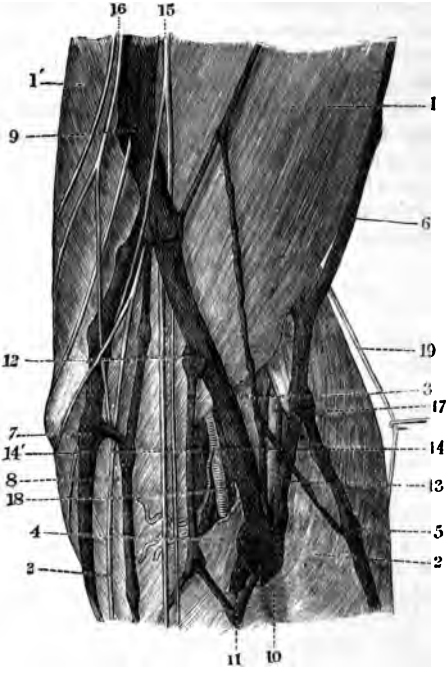


Fig. 30.—Bend of Elbow. (One-half.)
, 1', brachial aponeurosis; 2, 2, anti-brachial aponeurosis; 3, slip of brachial aponeurosis, passing to the muscles attached to the external condyle; 4, bicipital fascia; 5, superficial radial vein; 6, cephalic vein; 7, epitrochlea; 8, superficial ulnar vein; 9, basilic vein; 10, median vein; 11, deep radial vein; 12, median basilic vein; 13, median cephalic vein; 14, 14', abnormal vessels; 15, 16, internal cutaneous nerve; 17, external cutaneous nerve; 18, brachial artery and venæ comites; 19, cutaneous branch of musculo-spiral nerve.

level; and in flexion, at a right angle below the level of the condyles.

Bend of elbow. — *Anterior* aspect. — Beneath the

in, which is thin, lax, and plicated, is the subcu-
aeous cellular tissue, in which lie the cutaneous
rves, separated from an important plexus of veins
d lymphatics by the superficial aponeurosis. The
ds in the skin are constant, and depend upon the
veral movements of the limb being placed well above
e interarticular spaces. These serve as useful guides in
erations. In fracture of the inferior extremity of the
merus, the transverse fold lies below, or on the level
ith the upper fragment, and in dislocation it is slightly
ove it. The nerves are derived from the internal
taneous, lesser internal cutaneous, median and mus-
lo-cutaneous. The superficial veins are derived
incipally from the radial, ulnar, and median veins,
nd at the inner border of the biceps tendon the median
ins the basilic, by means of a large oblique branch,
e median basilic; and also the cephalic, by a similar
anch; the median cephalic lies along the lower
rder of the biceps. At the point of bifurcation, the
oneurosis of the forearm is perforated by a communi-
tion between these veins and those accompanying the
achial artery, also between the superficial and deep
mphatics. The aponeurosis of the bend of the elbow
a continuation of the brachial, and is strengthened
ternally by an offset from the tendon of the biceps
he bicipital fascia). It is this process which separates
e median basilic vein from the brachial artery. It
ceives, moreover, posteriorly a slip from the tendon
the triceps, is attached to both condyles, and has
further slip from the brachialis anticus tendon.

Beneath the aponeurosis is the mass of muscles
ich form the boundaries of the space. *Externally*,
m above downwards, in order, are the supinator
ngus, extensor carpi radialis longior and brevior,
vering the lower and external part of the humerus,
d the external lateral ligament. *Internally*, the
mmon tendon of origin of the flexors and pronators
the wrist and forearm above; and passing between
ese *muscular masses* are, externally, the tendon of the

biceps; internally, the tendon of the brachialis anti covering in the anterior part of the articulation, par the head of the radius, and the coronoid proc These muscles form two wedge-like troughs, in outer of which lie the musculo-spiral nerve, supe profunda and radial recurrent vessels; in the inner, brachial artery, with its venæ comites, and the mec nerve.

The brachial artery at the bend of the elbow lie: the middle of this space, at first superficial, and af wards, before it divides, deep, and opposite the coron process forms the radial and ulnar, and has the foll ing relations:—In *front*, integument and superfi fascia, median basilic vein, bicipital fascia; *externa* tendon of biceps; *internally*, median nerve; *posterio* the brachialis anticus.

The *lymphatics* are both superficial and deep, former lying upon the aponeurosis, and communicat with one or more large glands immediately over anterior aspect of the inner condyle; these gla become enlarged in poisoned wounds of the finger, indurated in constitutional syphilis. The deep l phatics follow the course of the arteries.

This aspect of the region is of the highest surg importance, as in the operation of bleeding from median basilic vein, there is a chance of wounding brachial artery; in the event of such an accid occurring, either an aneurismal varix, or vari aneurism, or a diffuse or circumscribed traumatic ar rism, might be the result. Arterial hæmorrhage fi wounds in this region, can be generally controlled extreme flexion of the arm, aided by a pad of lint small roller. Owing to the great number of ino lating vessels lying round the joint, there is co derable chance of secondary hæmorrhage.

The *posterior* aspect of the region of the elb presents for examination the olecranon process of *ulna*, between which and the integument is a bur *external* to the olecranon can be felt the articula

of the head of the radius with the capitellum; and internally a deep depression, between it and the projecting inner condyle, in which lies the ulnar nerve and posterior ulnar recurrent artery, passing between the two heads of the flexor carpi ulnaris. The posi-

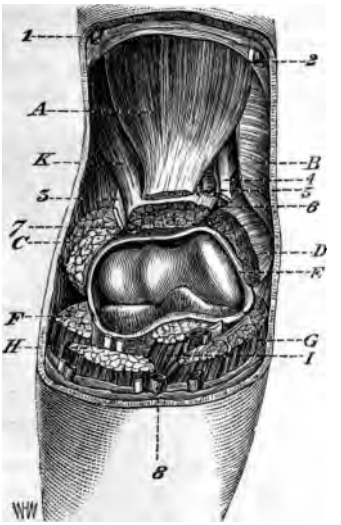


Fig. 31.—Structures in Relation with the Anterior Aspect of the Elbow-joint.

1, cephalic vein; 2, basilic vein and internal cutaneous nerve; 3, musculo-spiral nerve; 4, median nerve; 5, brachial artery and venæ comites; 6, anastomotica magna; 7, radial recurrent; 8, median vein; A, biceps; B, triceps; C, supinator longus and extensor carpi radialis longior (the division between them is not evident enough). D, origins of flexors and pronators; E, capsule of joint; F, extensor carpi radialis longior; G, pronator teres; H, supinator longus; I, tendon of biceps (beneath which is the brachialis anticus and the capsule).

tion of this nerve must be borne in mind in resection of the elbow-joint, and it must be carefully isolated, and hooked out of the way in the course of the operation, to avoid injury. The artery is only

protected in this operation by the brachialis antic so that after the bones are divided, the knife must used cautiously. The great vascularity of the reg of the elbow-joint is, no doubt, one cause of the s cess attending its excision, the inosculating branc being the superior and inferior profundæ, anastomot magna, anterior and posterior ulnar recurrent, in osseous recurrent, and radial recurrent. It is wor of notice that the nutrient vessels of the humer radius, and ulna run *towards* the elbow-joint.

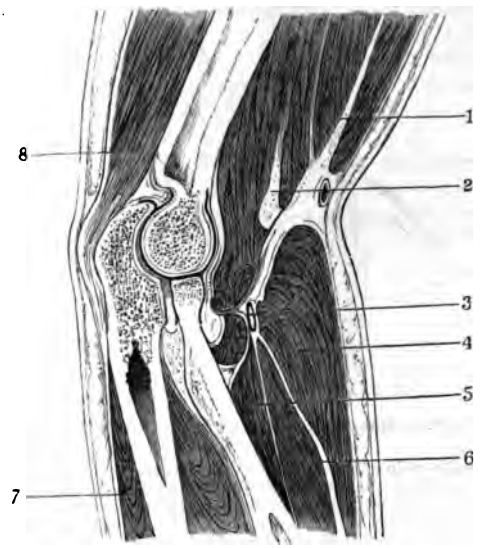


Fig. 32.—Longitudinal Section of Elbow-joint. (One-half.
1, biceps; 2, brachialis anticus; 3, musculo-spiral nerve; 4, su nator longus; 5, supinator brevis; 6, extensor carpi radi longior; 7, extensor carpi ulnaris; 8, triceps.

Vertical section through the elbow-joint.—Skin a integument, containing the superficial veins and ner *already* described, aponeurosis of arm, supinator long

pronator teres, brachial artery and veins, and median nerve and musculo-spiral nerve, extensor carpi radialis longior, tendon of biceps, brachialis anticus, supinator brevis, flexor carpi radialis, extensor carpi radialis brevior, external and internal lateral ligaments, flexor sublimis, ulnar nerve, extensor carpi ulnaris, flexor carpi ulnaris, anconeus, olecranon, and olecranon bursa, and then the integument.

The *articulation of the elbow-joint* admits of flexion and extension, and the direction of the articular surfaces not being parallel to a line drawn through the condyle, it follows that the axis of the forearm is not continuous with that of the arm, the trochlear surface being lower down than the capitellum. The *ligaments* connecting the bones of the joint are very strong—namely, an

Fig. 33.—Vertical Section of Elbow. (One-half.)
1, pronator teres; 2, median nerve; 3, flexor carpi radialis; 4, internal lateral ligament; 5, ulnar nerve; 6, olecranon; 7, tendon of triceps; 8, anconeus; 9, extensor carpi radialis longior; 10, brachialis anticus; 11, radial nerve; 12, supinator longus; 13, tendon of biceps.

anterior, a posterior, and two lateral, whilst there is a very large synovial membrane, the arrangement of which, in diseases of the articulation, causes the swelling to take place posteriorly on either side of the olecranon, and anteriorly at the bottom of the fold at the bend of the elbow.

Fractures of the humerus, in the region of the joint, frequently *implicate it,* and are to be distinguished

from dislocation by there not being the change in t normal relation of *three* bony processes—viz., the o cranon, epicondyle, and epitrochlea. The inter condyle should be midway between the last rib a the iliac crest, as the arm hangs by the side. In tension of the forearm, the olecranon is about an i away from the internal condyle, and on the same le with it—in flexion at a right angle it is an inch a a half away from it and below it. Almost any form dislocation may exist, but the most common is that both bones of the forearm backwards, the strength the lateral ligaments being a great obstacle to late displacement.

The *dislocations* to which the articulations of elbow-joint are liable are, in the first place, of b radius and ulna, backwards, outwards, inwards, wards; of the radius only, forwards and backwar and of the ulna only, backwards. The difficulties the diagnosis of these several conditions are frequen enhanced from the complication with fracture or sepa tion of the epiphyses, the union of which with the sh takes place as follows:—the outer condyle and b portions of the articulating extremity of the hume at the *sixteenth or seventeenth year*, the inner cond at the *eighteenth* year, whilst the superior artic extremities of the radius and ulna unite with th shafts at *puberty*. It may be here remarked that i not the *complete* dislocations or fractures which difficult to diagnose, but the *incomplete* or *partial*.

SURGICAL ANATOMY OF THE FOREARM.

Surface markings.—The front of the forearm, or a brachial region, may be described as lying between lower margin of that assigned to the elbow and the fold seen in front of the wrist-joint. In shape it is of a flattened cone, which varies in form accordin the limb is pronated or supinated, the roundness of *lateral* boundaries being due to the flexors and pron

he inner, and the supinators and extensors on
. The bones, the radius and ulna, are capable
felt almost entirely throughout the region,
ly the ulna, the posterior border of which is
ous from the olecranon to the styloid process;
s, however, has its shaft thickly covered with
nd is felt with greater difficulty, and the
endons of the muscles clothing them are
en on putting them in action. The radial
pulses are seen in the lower part, while the
be felt in the upper along the inner border
ss of muscles at the radial side.

aphy.—Beneath the skin, which is thin and
and provided with hairs, the subcutaneous
met with, containing a good deal of fat, in
the superficial veins and cutaneous nerves
phatics. Beneath this layer is the ante-
aponeurosis, continuous with that already
at the elbow. It is dense, tough, and by its
ion forms fibrous sheaths for the muscles and
uctures of the region. This general ante-
aponeurosis may be considered as forming into
f compartments, attached laterally to the
d ulna; thus the anterior is bounded by the
lamina, the anterior surfaces of the radius,
interosseous membrane, and the posterior by
ior surface of these bones and the interosseous
e, and by the aponeurosis.

terior of these compartments contains from
ce to the interosseous membrane, the integu-
he forearm, aponeurosis, the radial vessels and
ing in a cellular interspace between the radial
r mass of muscles, pronator teres as far as the
ird, palmaris longus, flexor carpi radialis and
the inner aspect, and the supinator longus, ex-
pi radialis, longior and brevior on the outer
neath which muscles are the supinator brevis,
sublimis *digitorum*, median nerve, and ulnar
d nerve, flexor profundus, and flexor longus

pollicis, lying on the bones and interosseous memb
In the lower third, the tendons of the muscles pa
to the wrist lie over the pronator quadratus, and
the membrane itself the anterior interosseous v
and nerves.

The posterior compartment contains from the su
to the bones the extensor communis digitorum, sli

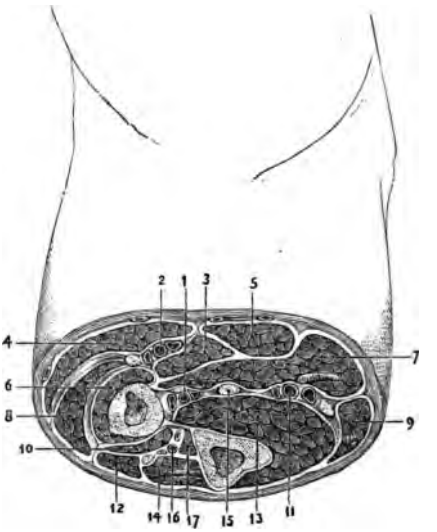


Fig. 34.—Section through the Middle of the Right Fores

1, anterior interosseous **vessels and nerve**; 2, radial vesse
nerve; 3, pronator teres; 4, supinator **longus**; 5, **flexor**
radialis; 6, supinator brevis; 7, flexor sublimis **digitor**
extensores carpi radialis longior and brevior; 9, flexor
ulnaris; 10, extensor ossis metacarpi pollicis; 11, ulnar
and nerve; 12, extensor communis digitorum; 13, flexo
fundus digitorum; 14, extensor carpi ulnaris; 15, n
nerve; 16, posterior interosseous vessels and nerve; 17, ex
secundi internodii pollicis.

covered in above by the extensor carpi radialis lo
and lower down, lying along the extensor carpi ra

rvior, extensor minimi digiti, extensor carpi ulnaris, id anconeus. The second layer comprises the exten- r ossis metacarpi, primi and secundi internodii llicis, the extensor indicis, and the posterior inter- seous vessels and nerves. The extensors of the umb will be seen to form a sort of spiral round the wer part of the radius; they are enclosed in a sheath hich is very liable to be the seat of severe teno- novitis, especially met with in reapers and labourers.

Relations of the radial artery in the forearm.—Sup- sing the vessel to be normal, a line drawn from the iddle of the bend of the elbow to the inner side of e styloid process of the radius represents its *course* in e upper third; it is concealed by the pronator teres d by the edge of the supinator longus, and lies on e tendon of the biceps, and in a bed of fat and lular tissue, in relation with some muscular branches the musculo-spiral nerve, and on the supinator evis. In the middle third it lies between the ndons of the flexor carpi radialis and supinator ngus, having the radial nerve to its outer side, and the pronator teres and flat head of flexor sublimis. the inferior third it has the same tendons on either e, whilst it rests upon the flexor longus pollicis, nator quadratus, and radius. It is accompanied roughout by venæ comites.

To tie the radial artery.—The vessel is readily ured throughout its course, and any incisions made rough the integument along the margin of the pinator or its tendon would reach it, but its deliga- n on the upper third is only required in cases of und, which, in such instances, would be en- ged, and the vessel tied above and below the point injury. The vessel is liable to several irregularities, e most common of which is a high origin from the achial, when it lies often merely subcutaneous and n be seen pulsating throughout its course.

Relations of the ulnar artery in the forearm.—rising *at the bifurcation* of the brachial, it runs

obliquely downwards, on the ulnar side of tl towards the radial side of the pisiform bone, an upper third it is covered by the pronator teres carpi radialis, palmaris longus, and flexor sublim having on its inner side the flexor carpi ulnaris outer the flexor sublimis, and resting on the br anticus. In the lower two-thirds, it is covered the fasciæ; on its inner side are the flexor carpi and ulnar nerve, on its outer the flexor sublimis, rests on the flexor profundus; venæ comites acc it throughout. This vessel occasionally arises h when it also lies immediately beneath the inte and fasciæ, uncovered by muscles. The same r with regard to tying it in the upper third of tl may be made as have been in the case of the rad is very difficult to secure in its upper third, ov being so covered in by muscles.

The *nerves* of the forearm are cutaneous an the former being branches of the external and i cutaneous as far as the wrist, of the lesser i cutaneous and musculo-spiral, and in the lowe of the ulnar and radial.

The musculo-spiral enters the forearm betw brachialis anticus and supinator longus, an breaking up in the supinator brevis is distrib the extensors and supinators; the median ent forearm between the two heads of the pronat and is accompanied by a vessel, the comes mediani, which is occasionally of considerable si may form one of the chief supplies to the pal ulnar enters the forearm between the two heads flexor carpi ulnaris, and accompanies the ulnar

In amputation through the upper third of t arm the flaps would contain the structures as foll In the *anterior*, integument and superficial ve nerves, the flexor carpi radialis, supinator palmaris longus, flexor carpi ulnaris, extenso radialis longior, pronator teres, flexor sublin profundus, and the radial, ulnar, and anterio

osseous vessels and nerves. The *posterior*, the extensor carpi radialis brevior, supinator brevis, and the ulnar and common extensor of the fingers, with the posterior interosseous vessels and nerves, integuments, and superficial veins and nerves. The vessels requiring ligature are the radial and ulnar, which will be found just beneath the integument, the anterior and posterior interosseous, which retract along the interosseous membrane, and perhaps the comes nervi mediani.

In performing the flap amputation the bones should be placed midway between pronation and supination; and in cases of simple fracture of one or both bones, the same position must be maintained, as they are then most nearly parallel and furthest separated from each other, and there is less chance of any union between them. Moreover, owing to the tendency to motion that exists between these bones, a false joint may be the result unless accurate adaptation and perfect rest be maintained.

The fractures which occur in the forearm are those affecting either one or both bones and their processes. If the coronoid process be fractured—a rare accident, dependent on muscular action or dislocation—that amount of flexion performed by the brachialis anticus is necessarily lost; symptoms of fracture of the olecranon are obvious, and the powerful action of the triceps in separating the fragments accounts for the rarity of bony union; moreover, the articulation is generally opened. If the neck of the radius be fractured, a result of direct violence, the diagnosis is obscure, and must be deduced from the want of power of *voluntary* pronation and supination.

The *action of the muscles* of the forearm upon fragments is well marked in such a case as fracture of the shaft of the radius alone. Thus, supposing it broken about its centre, the upper fragment is drawn forwards by the biceps, inwards by the pronator teres; the lower fragment is pronated and drawn downwards and inwards by *the pronator quadratus*, and its styloid process

tilted upwards by the supinator longus. In fract of both bones the action of the muscles often ca great deformity.

SURGICAL ANATOMY OF THE REGION OF T WRIST.

Surface markings. — Beneath the integument seen the cutaneous veins and the tendons of muscles acting on the wrist and fingers, the *ante* ones being most evident in flexion of the hanc clenching the fist, especially the palmaris longus flexor carpi radialis; the *posterior*, in extension of wrist or fingers, and in extension of the thumb. position of the styloid processes of the radius and can be felt, the former lower down than the latter; relation of these processes, however, is altered du pronation and supination. In front of the sty process of the radius is the root of the thumb prominence of the scaphoid, and on the inner sid the pisiform bone, with the tendon of the flexor c ulnaris attached to it. The pulsations of the radial ulnar arteries can be easily felt and generally seen; former on the radial side of the flexor carpi radi the latter on the radial side of the flexor carpi ulna

Topography.—Beneath the skin is the subcutan cellular tissue, free from fat, and lying in it are cutaneous vessels, nerves, and lymphatics. The neurosis is a continuation of that forming the sh of the muscles of the forearm, which is remarkabl the wrist as being very strong, and affording sp channels for the passage of the tendons of the mu of the forearm. It consists of two portions—an a rior, very thick and strong (anterior annular ligam continuous with the deep fascia of the forearm, w is attached to the pisiform, unciform. radius, scap and trapezium, receiving an expansion of the te of the palmaris longus, and forming an arch bet the thenar and hypothenar regions; and a poste *dense*, and formed of circular and longitudinal bur

of tissue attached to the ulna, cuneiform, pisiform bones, to the radius, and to the several eminences on its dorsal aspect, which separate the extensor tendons, and thus form six compartments, each lined with a separate synovial membrane.

Anterior region of wrist.—The first layer of structures beneath the integument and aponeurosis of the wrist, followed from the radial towards the ulnar side, consists of — the supinator longus, the radial vessels, the flexor carpi radialis and palmaris longus,

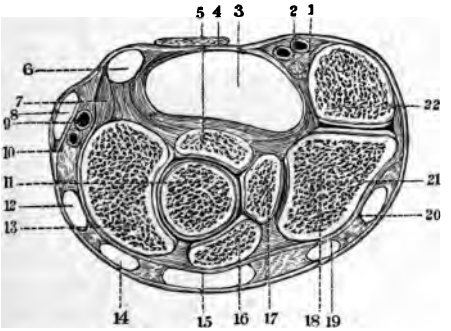


Fig. 35.—Transverse Section of Wrist, through the Middle of the Pisiform Bone.

1, ulnar vessels; 2, ulnar nerve; 3, sheath of flexors sublimis and profundus digitorum and flexor longus pollicis, enclosed by true annular ligament; 4, cut tendon of palmaris longus: 5, semilunar bone; 6, sheath for flexor carpi radialis; 7, radial origin of annular ligament; 8, 10, sheath for extensor ossis metacarpi and primi internodii pollicis; 9, radial vessels; 11, os magnum; 12, sheath of extensor secundi internodii pollicis; 13, scaphoid; 14, sheath of extensor carpi radialis, longior and brevior: 15, sheath of extensor communis and indicator; 16, semilunar; 17, unciform; 18, 21, cuneiform; 19, sheath of extensor minimi digiti; 20, sheath of extensor carpi ulnaris; 22, pisiform.

the former of which perforates the denser portion of the annular ligament, the ulnar vessels and nerve, and the flexor carpi ulnaris. All these tendons have separate *sheaths, derived from* the annular ligament and

synovial membranes. The second layer consists o flexor sublimis, enveloped in synovial membrane the median nerve, with its accompanying artery. third consists of the flexor longus pollicis and flexor profundus digitorum, having their syn sheaths in common with the superficial flexor, close on the bone are the carpal branches of the r and ulnar.

The posterior region.—Between the skin of back of the hand and the fascia are a nu of superficial veins and cutaneous nerves, de

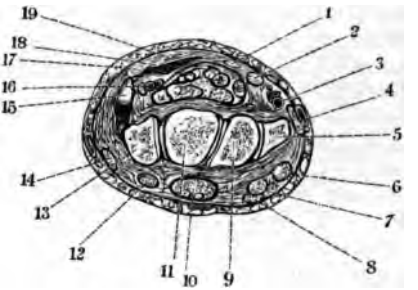


Fig. 36.—Section of Carpus, through the first row of car bones (one-half).

1, palmaris longus; 2, flexor carpis radialis; 3, radial v 4, supinator longus; 5, radius; 6, extensor carpi radialis lo 7, extensor carpi radialis brevior; 8, extensor longus po 9, scaphoid; 10, extensor communis digitorum; 11, semi- 12, extensor minimi digiti: 13, cuneiform; 14, extensor ulnaris; 15, pisiform; 16, ulnar vessels and nerve; 17, carpi ulnaris: 18, flexor brevis minimi digiti; 19, a annular ligament. (The flexors sublimis and profundus the unfigured space.)

from the radial and dorsal branch of the Beneath these is a strong fibrous membrane, appa continuous with the dorsal portion of the an ligament. There is a deeper layer, covering the and interossei, which is blended with the p aponeurosis laterally, the dorsal tendons pass be

these layers. Beneath the annular ligament are the six compartments for the following tendons, beginning on the radial side:—(1) extensores ossis metacarpi and primi internodii pollicis; (2) extensores carpi radialis, longior, and brevior; (3) extensor secundi internodii pollicis, crossing the two last mentioned very obliquely; (4) extensores digitorum and indicis; (5) extensor minimi digiti; (6) extensor carpi ulnaris.

The tendons of the extensor muscles, having arrived at the metacarpo-phalangeal articulation, receive the tendons of the lumbricales and interossei, whilst at the first pharyngeal joint they divide into three fasciculi, the central one being inserted into the base of the second phalanx, and the two lateral passing on and reuniting, are inserted into the base of the ungual. They have no distinct synovial sheaths.

The radial artery at the wrist can be felt or seen beating between the tendons of the flexor carpi radialis and supinator longus, where it is quite superficial and easily secured. Accompanied by venæ comites, it winds round the outside of the wrist, to gain the first interosseous space, when it enters the palm between the two heads of the first dorsal interosseous, and is crossed by the extensors of the thumb. It is readily secured at the base of the well-marked hollow formed by these muscles. In disarticulation of the metacarpal bone of the thumb it stands a chance of being divided, but if the knife be kept close to the bone it can be avoided. The most important branch of the radial is the superficial volar, which ordinarily lies subcutaneously, and completes the superficial arch. The other branches given off at the wrist supply the carpus and dorsal aspects of the thumb and first finger.

The ulnar artery, at the wrist, lies with its venæ comites, on the radial side of the flexor carpi ulnaris, and with its nerve to its inner side.

Articulations of the wrist-joint.—These are the inferior radio-ulnar, the radio-carpal, which exist between the *lower end of the radius*, and the scaphoid, and semi-

lunar bones. The synovial membrane of this articul tion is also extended over the cuneiform bone and th inter-articular fibro-cartilage between the ulna and th bone; the inter-carpal and carpo-metacarpal join which include the anterior articular surfaces of t cuneiform, semilunar, and scaphoid, the entire ur form, os magnum, and trapezoid, with the bases of four inner metacarpals, have a common synovial m brane, whilst the pisiform and the trapezium have each. Of these articulations the most important to

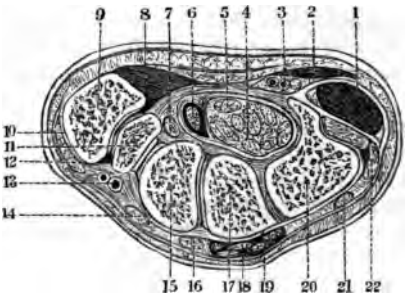


Fig. 37.—Section of Carpus through the middle. (Two-thir

1, hypothenar muscles; 2, palmaris brevis; 3, ulnar vessels nerve; 4, flexor sublimis and profundus; 5, median nerve flexor longus pollicis; 7, flexor carpi radialis; 8, thenar musc 9, base of first metacarpal bone; 10, extensor ossis metac pollicis; 11, trapezium; 12, extensor primi internodii pollicis radial vessels; 14, extensor carpi radialis longior; 15, trapez 16, external carpi radialis brevior; 17, os magnum; 18, exte indicis; 19, extensor communis digitorum; 20, unciform; extensor minimi digiti; 22, extensor carpi ulnaris.

surgeon is the radio-carpal, as dislocation of the h and carpus from the radius, either backwards or wards, takes place here. Moreover, amputation occasionally performed at this joint.

Fracture of the radius just above the articulat (Colles's fracture) is almost always transverse, and young subjects the lower epiphysis is occasionally s*rated*. In these injuries the deformity is well mark

the result of the combined action of the supinator longus, extensors of thumb, and radial extensors of the wrist causes the lower fragment to make a partial rotation on its transverse axis.

In examining the lower end of the forearm, in

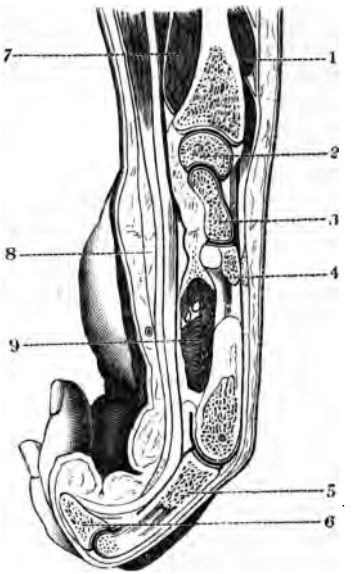


Fig. 38.—Longitudinal Section of the Wrist-Joint through the Radius and Middle Finger. (One-half.)

1, extensor primi internodii pollicis; 2, semi-lunar bone; 3, os magnum; 4, middle metatarsal bone; 5, first phalanx; 6, second phalanx; 7, pronator quadratus; 8, annular ligament; 9, adductor pollicis.

cases of injury, it must be remembered that the *head* of the ulna is prominent in *pronation*, and its *styloid* process in *supination*, owing to the rotation of the *radius at its inferior* radio-ulnar articulation.

Amputation at the wrist-joint may be performed

either by a semilunar dorsal flap, and an anteri formed from the palm, or by rectangular flaps. T knife may get notched against the pisiform bone, that some little neatness is necessary in avoiding it. T styloid processes of the radius and ulna require remov and the vessels which would be ligatured are t superficialis volæ, some branches of the ulnar in pal and perhaps an abnormal median.

For the operation of *excision* of the joint, an ac rate knowledge of its component parts and relations of the utmost importance, as this excision, like that the ankle, reduces itself to an anatomical problem viz., to remove the disease, and at the same time preserve to the hand the tendons passing from the a to it, and if possible to retain their functions.

SURGICAL ANATOMY OF THE HAND.

PALMAR REGION.

Surface markings.—This region extends from t wrist to the web of the fingers. It is concave, and p sents two muscular eminences: one on the radial sic due to the mass of muscles acting on the thumb, call the *thenar* prominence, and the other due to muscles the little finger, the *hypothenar*. The intermedia space is marked by several furrows, indicating the mo marked flexions of the hand, one of which, the obliq central one, lies almost in the course of the superfici palmar arch. The deep palmar arch may be referr to the surface marking, by an imaginary line draw between the centres of those circles, which form tl bases of the thenar and hypothenar eminences. Tl root of each finger presents a longitudinal depressio placed in front of the superior extremity of the fir phalanx. The bifurcation of the digital vessels tak place a little nearer the palm than the web of tl *fingers*, and their course is subsequently along the und *lateral* aspects of the digits.

The skin is very thick and adherent and very sensitive, notwithstanding the horny condition it acquires in those who have much manual labour, and it is furrowed by ridges, in which lie the orifices of the sweat

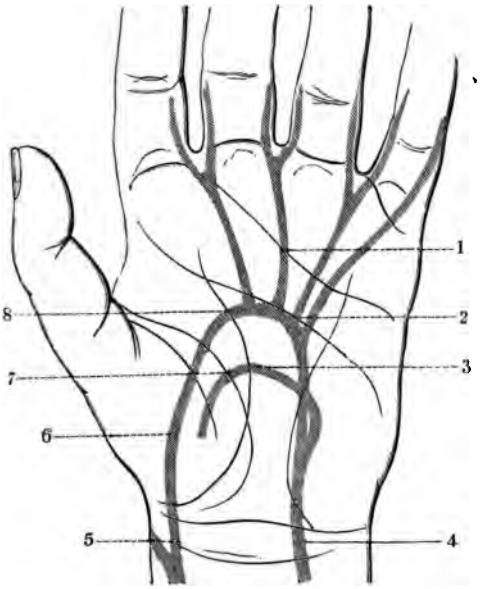


Fig. 39.—Relation of the Palmar Arches to the Folds of the Palm.

1, inferior fold; 2, middle fold; 3, superior fold; 4, ulnar artery; 5, radial artery; 6, superficialis volæ; 7, deep palmar arch; 8, superficial palmar arch.

ducts. The great vascularity of the skin of the palm predisposes this region to the occurrence of erectile tumours.

Topography.—The subcutaneous tissue is full of lobulated fat; beneath the fat and cellular tissue is the *palmar fascia*, particularly strong in its central fasci-

culus, and into the posterior portion of which is inser the palmaris longus, opposite the heads of the m carpal bones it divides into four slips, which s themselves divide into two processes, attached to sides of the first phalanx, giving passage to the fle tendons, whilst the intermediate spaces transmit digital vessels and nerves. Vertical septa pass do and divide the central set of palmar muscles from t thenar and hypothenar, the expansion of the palm fascia covering which is very thin. It will be obser that there is a great difference between the superfic and deep surfaces of the fascia; the former bei rough and coarse, whilst the deep is polished a shining, owing to the reflection on to it of the bur tissue of the sheaths of the tendons. This palm aponeurosis is frequently the seat of contraction whi implicates the fingers. The little palmaris bre muscle is attached to the skin and ulnar portion the central portion of the aponeurosis.

On removing the palmar fascia the underlyi structures are met with in the following order, disse ing down to the metacarpus. Commencing with t *thenar* eminence, beneath the fascial covering, lie t superficialis volæ artery, abductor pollicis, oppone pollicis, and radial head of short flexor of thum tendon of flexor longus pollicis, ulnar head of flex brevis pollicis, princeps pollicis, and radialis indi arteries, metacarpal bone of thumb, trapezium, a tendon of flexor carpi radialis.

In the middle segment of the palm, between t central fasciculus of the palmar fascia and the anteri annular ligament, with which the fascia is continuou lie the superficial palmar arch and its digital branch and the ulnar nerve, the median nerve, with its digit branches, the tendons of the flexor sublimis and p fundus digitorum, with which latter are associated t lumbricales (these muscles enclosed in their synovi *sheaths*), lie under the annular ligament, next a lay *of fibrous* tissue separating these from the deep ar

the deep branch of the ulnar artery, the adductor of thumb and interossei, whose tendons, with those of the lumbricales, pass into the general dorsal aponeurosis, and lastly, the metacarpus.

Beneath the palmar fascia of the *hypothenar* eminence lie the palmaris brevis, some cutaneous vessels and nerves, the abductor and flexor brevis, minimi digiti, the commencement of the superficial palmar arch, with its accompanying ulnar nerve, opponens minimi digiti, deep branch of ulnar artery and nerve, and fifth metacarpal bone.

The metacarpal bone of the thumb articulates with the trapezium by a saddle-shaped surface, and its shaft is considerably curved anteriorly; and in amputation at the metacarpo-trapezial joint, the secret of separating the bone neatly consists in abducting it forcibly and dividing the lateral ligaments, of which it is better to cut the inner one first. There are several methods of performing this operation, but that should always be chosen which will leave the greatest amount of *opposing* structure; as the muscular pad, resulting from the flaps, even though it loses its bony support, is of great importance when the hypothenar mass of muscle is intact, as it will in a great measure retain the power of approximation. Care must be taken to avoid wounding the trunk of the radial artery, as it passes between the two heads of the first dorsal interosseous muscle, if possible. The metacarpal bones of the fingers, having a common synovial membrane with their carpal bones, ought, if possible, to be removed without disarticulation, owing to the liability of general suppuration. There is some little difficulty attending amputation of the fifth metacarpal bone, owing to its double articulation with the os unciforme.

Synovial membranes of the palm.—These sheaths for the flexor tendons are arranged thus, generally:—1. That of the flexor longus pollicis, which extends from the extremity of the thumb to about half-an-inch *above the annular* ligament. 2. That common

to the tendons of the flexor sublimis and profun digitorum. It extends from about half-an-inch ab the annular ligament, and is separated from the] ceding by the median nerve. It expands in palm, and has three prolongations; the two first associated with the tendons of the index and mid fingers, and the third is common to the tendons the ring and little fingers.

Abscess in the palm (*palmar abscess*), unless ope early, is liable to spread up the arm, along the sy vial sheaths of the muscles, by passing beneath

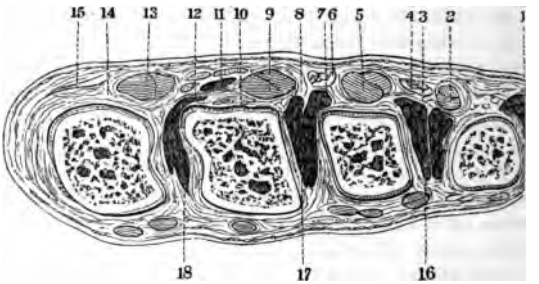


Fig. 40—Horizontal Section of the Hand through the Car Metacarpal Joints.

1, hypothenar muscles; 2, 5, 9, 13, flexor tendons in the she 4, 6, 11, lumbricales; 8, volar aponeurosis; 10, 14, deep v aponeurosis; 3, 12, anterior carpal ligament; 16, 17, interossei.

annular ligament, the excruciating pain attending being due to the tenseness of the palmar fascia. opening collections of pus in the palm, the position the palmar arch must be recollected, and the ki should be entered upon the head or neck of metacarpal bone, and not *between* the fingers, that the bifurcation of the digital artery may avoided.

The superficial palmar arch is formed by the ul

artery, which enters the palm on the radial side of the pisiform bone, and lies beneath the palmaris brevis and on the annular ligament. The ulnar nerve is on its inner side, and it is accompanied by venæ comites, opposite the position of the intercarpal articulation, it sends a branch to join the deep arch, accompanied by the deep branch of the ulnar nerve, penetrating between the abductor and flexor brevis minimi digiti. At about this point the superficial arch commences; its convexity being forwards, and extending to, and gradually lessening as it approaches the interspace between the ball of the thumb and the index finger, where it anastomoses with the superficialis volæ, and thus completes the arch. It supplies the opposed surfaces of the index and middle, of the middle and ring, and the entire little finger. The digital branches arise from the arch by short common trunks, branching in the web of the fingers, and at this spot communicating branches are given off to the deep arch. The superficial arch is covered by the skin, subcutaneous cellular tissue, and by the palmar fascia, and is posteriorly in relation with the superficial and deep flexors, and the digital branches of the median and ulnar nerves, the lumbricales and bursal tissue of the flexor tendons.

The deep palmar arch is formed by the radial artery, which enters the palm by the first interosseous space, between the two heads of the first dorsal interosseous muscle, and takes a direction from without inwards, nearly transversely, beneath the flexor brevis and adductor pollicis—where it gives off the princeps pollicis and radialis indicis, which supply the thumb and radial side of the index finger—towards the base of the metacarpal bone of the little finger, at which point it anastomoses with the deep branch of the ulnar. It gives off interosseous branches and perforating branches, which pass backwards between the muscular fibres of the three *inner* interossei, and inosculate with the *dorsal interosseous* branches. The arch is

completed by its inosculation with the comm
branch of the ulnar artery.

The structures which lie between the
superficial arches are, the flexor tendons of t
and their sheaths, the lumbricales, part of t
brevis pollicis, and the muscles of the litt
The deep branch of the ulnar nerve accomp
deep arch. Beneath it are the carpal en
metacarpal bones and the interossei muscl

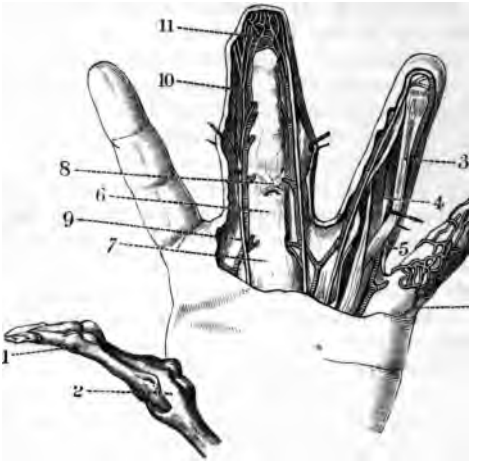


Fig. 41.—Anterior Aspect of Fingers.

1, 2, lateral ligaments; 3, flexor profundus digitorur sublimis; 5, cut edge of theca; 6, sheath of flexors; commencement of theca; 8, crossed fibres of theca nerves; 10, digital vessels; 11, termination of di and nerve; 12, 13, arrangement of veins.

deep arch is situated about half-an-inch r
wrist than the superficial arch.

In wounds of the palmar arch, if ligatu
radial and ulnar fail, the circulation is probal

on by an enlarged anterior interosseous or comes nervi mediani, and ligature of the brachial must be had recourse to.

Bursal swellings are commonly met with in association with the synovial sheaths of the flexor tendons in the palm, and generally communicate beneath the annular ligament, with the continuation of these sheaths in the forearm.

In the *fingers* the skin is very thick, particularly on the palmar aspect, highly vascular, and freely supplied with nerve-fibres. The subcutaneous tissue contains a good deal of fat; beneath this tissue is the sheath or theca of the flexor tendons, an osseo-fibrous canal, formed by the phalanges and a dense tube of fibrous tissue, disposed in circular and oblique bands, very thin immediately opposite the flexures, and perforated at the roots of the fingers for the passage of vessels and cellular tissue. The sheath is very thin on the palmar aspect of the ungual phalanx, and purulent infiltration into it is common at this point. The flexor tendons which lie in the sheath are those of the flexor sublimis (*perforatus*) attached by two slips to the sides of the second phalanges, and those of the flexor profundus (*perforans*) which divides them, and is inserted into the base of the ungual. The canal is lined with a synovial membrane, which is reflected on to the tendons. Slender tendinous filaments, called *vincula*, connect these tendons to the walls of the canal. On the dorsum there is a strong aponeurosis formed by the extensor tendons, further strengthened by the expansion of the interossei and lumbricales. The common extensor passes on to the second phalangeal articulation, opposite which it divides into three fasciculi, the central one being inserted into the base of the second phalanx, whilst the two lateral slips reunite and pass on, to be inserted into the base of the ungual.

The synovial sheaths of the flexor tendons of the *thumb and little* finger communicate with the common *sheath, whilst those* of the other three do not, a fact

which accounts for the greater frequency of supp in the common sheath when whitlow occurs ir of them.

In *excision* of the phalangeal articulation necessary to retain as much as possible of the aponeurosis, in order that the power of extensi be afterwards preserved. In *disarticulation* phalanx, it must be remembered that immediat lateral ligament is divided the joint is opene

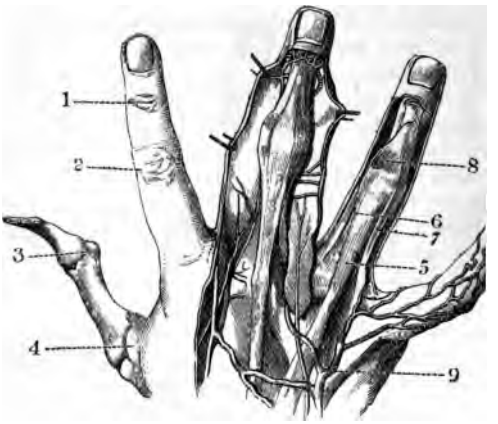


Fig. 42.—Dorsal Aspect of Fingers. (One-third.

1, 2, digital articulations and their corresponding ski 3, 4, lateral ligaments; 5, common extensor tendo lumbricales and interossei tendons; 8, splitting of tendon; 9, dorsal ulnar vein.

that this lateral ligament does not coincide w palmar fold of the digit, but is a little in fron so that the guide for entering the knife is the fold in the skin seen on the dorsal aspect of th

The *vessels* supplying the fingers, with the are derived from the digital branches of the *and ulnar* arteries. The arteries anastomose very f

the pulp and matrix of the nail. The veins accompany the arteries and pass posteriorly, and form a considerable plexus, passing along the back of the fingers into the veins of the back of the hand.

The digital *nerves* are derived from the radial, median, and ulnar. The branches of the radial are supplied to the posterior surfaces of the thumb and index, middle, and ring fingers; those from the median to the palmar surfaces of the same digits, and those from the ulnar to the inner half of the ring and both sides of the little finger.

Dislocation of the first phalanx of the thumb is difficult of reduction, and if reduced, of being maintained in position, owing to the great power exerted by the mass of muscles forming the ball of the thumb, and to the fact that when the phalanx lies on the dorsal aspect of the metacarpal bone, the narrow head of the latter becomes constricted by the two terminal attachments of the flexor brevis pollicis, the tendons of which are further strengthened by the conjoined insertion of the adductor and abductor.

CHAPTER V.

SURGICAL ANATOMY OF THE ABDOMEN.

On commencing the surgical anatomy of the abdom it is advisable to point out the relations of t contents of this cavity to the surface of the bo considerations of importance to the surgeon as a to diagnosis.

Relations of the viscera to the abdominal parietes In order to facilitate the description of the abdom it can be mapped out by certain arbitrary lines i nine regions, to which the contained viscera can referred—a method of reference of considerable in a certain way, but of no great value as bearing u the subject of Surgical Anatomy, properly so calle These lines are vertical and horizontal; the vertical p ing from the seventh costal cartilage to the middle Poupart's ligament, on either side, and the horizo through the level of the ninth costal cartilages, t crests of the ilia. The regions thus indicated are ca the—

Right hypochondriac.	Epigastric.	Left hypochondr
Right lumbar.	Umbilical.	Left lumbar.
Right iliac.	Hypogastric.	Left iliac.

The *epigastric* region contains the left lobe of liver, part of the anterior surface of the stomach w

* For a detailed account of the relations of the viscera to surface and each other, the reader is referred to Prof. Brau "*Atlas of Topographical Anatomy after sections of frozen bodi (Translated by Author.)*

ageal and pyloric orifices, the gastro-hepatic
and the foramen of Winslow. Behind the
the lesser bag of the peritoneum, second and
ions of the duodenum, the pancreas, cœliac
its branches, the superior mesenteric artery
plexus, the aorta and vena cava, and vertebral

ht hypochondriac region is almost entirely
y the right lobe of the liver; it contains also
is of the gall bladder, a portion of the
colon, the tip of the right kidney, and the
l capsule.
t hypochondriac region is almost entirely
the greater cul-de-sac of the stomach, the
l gastro-splenic omentum, and occasionally a
tion of the left lobe of the liver. Inferiorly
s the tip of the left kidney and supra-renal
small portion of the descending colon, and
the pancreas.
bilical region contains the great omentum, the
colon, the mass of the small intestine, the
, the aorta, and inferior vena cava.
nbar region contains convolutions of the small
the ascending colon on the right and the
g on the left, the kidneys and ureters, and a
of cellulo-fatty tissue.
pogastric region contains the great omentum,
intestine, and the bladder, if distended.
ac region contains the cœcum in the right,
igmoid flexure in the left, and convolution of
intestine.
be stated that in the female the gravid uterus
everal regions in succession, according to the
gestation.
gions of the abdomen will be considered under
of—
dominal parietes; (2) Such portions of the
l cavity as are of practical surgical import-
Pelvis.

ABDOMINAL PARIETES.

The region of the abdominal parietes may be div as follows—(1) Antero-lateral; (2) Inguinal; (3) Cr (4) Lumbar.

(1) *Antero-lateral region of the abdomen.—A graphy.*—The skin is very lax (excepting at the u lical depression), beneath it is the subcutaneous cel tissue and fascia, which latter may be divided int many lamellæ as the skill of the dissector permit two of which, however, may be considered as a for all surgical purposes, the superficial and the d The superficial lamina is continuous with that of thigh, and glides freely over Poupart's ligament, deep one is firmly attached to it. The position of t laminæ are clinically interesting, from the fact fluid or gas situated between them will descend tow the thigh, but supposing the effusion is behind deeper layer it is arrested by Poupart's ligament. T fasciæ are continuous, and interlace on either sid the linea alba, which is seen as a well-marked de sion, and some of their fibres are attached to it, an the lower portion of the abdomen pass downwar the scrotum, strengthening the suspensory ligame the penis, and giving origin to the dartos (*vide* Ing Region). In the fat existing between these la lie numerous cutaneous branches of the supe epigastric and intercostal vessels and nerves. A layer of cellular tissue separates the deep lay fascia from the external oblique muscle and its ap rosis. Next in order is the external oblique m the fibres of origin of which interdigitate with the the serratus magnus and latissimus dorsi, and aponeurosis passes inwards, to be inserted into the spine, the linea alba, and iliac and pubic crests. fibres of this muscle are oblique from above downw Beneath it lies the internal oblique, separated from a thin cellular membrane, derived originally from

lumbar aponeurosis, and in which lie filaments of the lower intercostal and last dorsal nerves; its tendon is inserted into the cartilages of the lower ribs, the linea alba, and ilio-pectineal line, enclosing the rectus for its upper two-thirds behind, and passing in front of it entirely for the remaining third. The fibres run in the contrary direction to those of the former muscle. The transversalis is separated from it by a thin cellular membrane, and having its origin from the lower ribs and lumbar aponeurosis is inserted along the linea alba and by the conjoined tendon, the upper three-fourths passing behind the rectus, and blending with the tendon of the internal oblique, whilst its lower fourth passes in front of it. It is separated from the peritoneum by the transversalis fascia. The rectus abdominis passes vertically down the abdominal parietes, on either side of the linea alba, enclosed in a partial sheath, and having three or four tendinous intersections, which are very readily seen beneath the skin when the muscle is in action. Below it is a little muscle, the pyramidalis, attached below to the pubis and inserted into the linea alba, at the junction of the middle with the lower third of the rectus. The continuity of the thin aponeurotic laminæ, which exist between the abdominal muscles, with the lumbar aponeuroses, accounts for the occasional pointing of lumbar abscess in the parietes, above Poupart's ligament, or at the edge of the rectus. The *deep epigastric* artery, with its veins, after passing between the peritoneum and transversalis fascia, gets behind it, and entering its fibres, freely anastomoses with the superior epigastric from the internal mammary, which vessel itself enters the rectus below the cartilages of the eighth or ninth ribs. Between the transversalis fascia and the peritoneum is the sub-peritoneal cellular tissue. The peritoneum itself closely lines this region of the abdominal wall, excepting for a short distance above the pubes, where its attachment is very lax—a circumstance taken advantage of in puncture of the bladder *in this region.*

The abdominal muscles are separated from one another by a lamina of cellular tissue, which favours the effusion of fluids, and the laxity of the sub-peritoneal layer explains reduction *en masse* or *en bloc* of a hernia, which instead of having been replaced *within* the peritoneal cavity, has been pushed back, unreduced, between either the muscles themselves or between the fascia tranversalis and the peritoneum.

Operations for the removal of abdominal tumours and for paracentesis abdominis are performed in the mesial line, as the simple structure of the linea alba presenting no *layers*, does not admit of infiltration into muscular aponeurosis or sheaths. In the operation of paracentesis the parietal layer of the peritoneum only would be involved; but in operations on an *ovarian cyst*, for example, both parietal and visceral are divided. In the case, however, of the incision through the parietes made for the application of ligatures to the iliac arteries, the abdominal muscles and fascia transversalis are divided, whilst the peritoneum is kept entire. The resilience of the walls of this region allows of the ready manipulation of its contents, with a view to diagnosis. Penetrating wounds are frequently followed by hernial protrusion, on account of the laxity of their cicatrices.

In the linea alba, between the two recti, is the *umbilicus*.

Umbilical hernia, of which there are several varieties, may be thus classified:—1. Congenital, which is a prolapse of the intestine into the cord, possessing no peritoneal covering. 2. In children, occurring from about the first to the fourth month, the coverings are the skin, the cicatricial membrane of the umbilical depression and the peritoneum; the fascia propria is so thin as to be almost unappreciable. 3. In adults, several varieties are met with as regards the shape of the opening and the contents. The opening may merely admit the finger tip, or the entire hand may *be passed* through it. As regards the coverings

ey are generally the same—skin, subcutaneous llular tissue, cicatricial tissue of the umbilical erture, fascia propria, sac, and sub-peritoneal cellular ssue. But these again may vary in texture, or in me cases be wanting.

The contents are most frequently omentum and the ansverse colon, small intestine without omentum, or ll these structures at the same time. In operating for trangulated umbilical hernia, it is of importance to livide the constriction downwards or inwards, and lownwards or outwards and downwards. In adults he hernia invariably contains omentum, which must e pushed upwards, in order to get at the intestine.

SURGICAL ANATOMY OF THE INGUINAL REGION.

This important region is the seat of operation in ases of inguinal hernia, for ligature of the external liac and epigastric arteries, and the pointing of bscesses of the iliac fossæ.

Surface markings.—This region (the inferior portion of the antero-lateral region of the abdomen) may e indicated superiorly by a line drawn from the anerior superior spine of the ilium to the mesial line f the body internally, and the mesial line itself elow Poupart's ligament. Between the bony prominences, the anterior superior spine externally, and the rest of the pubes internally, is a curved furrow, with s convexity downwards, indicating the fold of the roin, and the position of Poupart's ligament. Just bove the pubes can be felt the external abdominal ng, and the structures forming the cord are readily ecognizable.

The student should pass his finger up into the xternal ring without using any force, by tucking up he scrotal tissue upwards along the cord, in order to certain under what positions of the leg the examinaon of the *canal could* be most readily made, and the act *relations of the* structures composing it.

Topography. — The skin of this region is fre supplied with hairs, which must be carefully shav

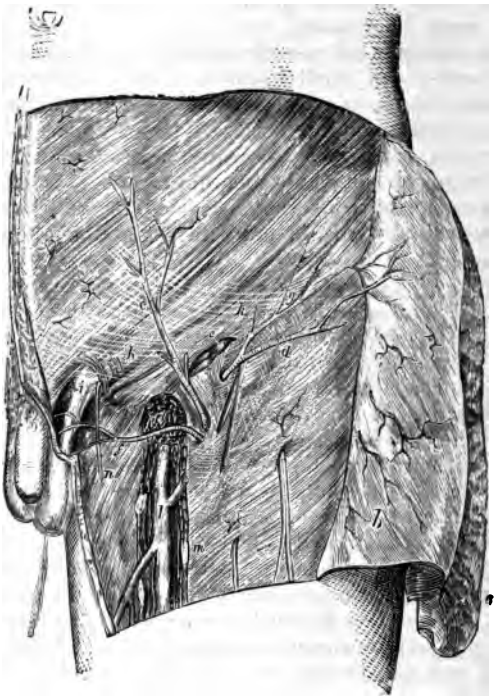


Fig. 43.—Superficial Dissection of the Inguinal and Femoral Regions.

a, superficial layer of fascia (reflected); *b*, deeper layer of fasci (reflected), the superficial vessels being left attached to th external oblique; *c*, inguinal lymphatic glands; *d*, superficia circumflex iliac artery; *e*, superficial epigastric artery; *f* superior external pudic artery; *g*, Poupart's ligament; *h*, inter *columnar* fascia; *i*, external abdominal ring; *k*, arciform fibre *of external* oblique; *l*, internal saphena vein; *m*, femora *lymphatic* glands; *n*, ilio-inguinal nerve; *o*, saphenous openin

ore an operation is undertaken. Beneath it is erficial fascia, readily divisible into two layers, tween which lie the cutaneous vessels and lym-, the deep layer being closely attached to t's ligament and to the crest of the ilium. The ial layer of this fascia is freely moveable over bjacent aponeurosis, a circumstance which is advantage of by the surgeon in making his is down upon a strangulated hernia, when, to this laxity, by pinching up a fold of integu-nd transfixing it, he obtains a linear incision, does not include either sac or gut. It is, more-ken advantage of in introducing the needles in operation for the radical cure. Between these of fascia are the lymphatics, transmitting the rom the external genitals, the termination of -hypogastric and ilio-inguinal nerves, and three ial branches of the common femoral artery— ie superficial epigastric, superficial circumflex id superficial external pudic, with their accom-g veins. In plastic operations for the relief of rsion of the bladder, the superficial epigastric be carefully preserved to nourish the flaps. h the deep layer of the superficial fascia is the rosis of the external oblique; its lower portion, inion with the fascia lata and deep fascia, forms *ural arch*, which extends from the anterior r spine of the ilium to the spine of the pubes, also an attachment to the ilio-pectineal line rnat's ligament). The attachment to the ilio-al line is strengthened by a triangular band of assing upwards and inwards towards the linea hind the inner pillar of the external ring. It noticed that extension and abduction of the ders the crural arch tense, so that in the exami-of the parts or in the application of the *taxis*, ernal abdominal ring must be relaxed by flexion duction. *The two pillars* of the external ring *nd together* by a set of aponeurotic fibres, which

interlace, more or less, over the whole of the inner part of this region, constituting the *intercolumnar bands*, from which a fascia is derived, forming a covering to the emerging cord—the *intercolumnar* or *external spermatic* fascia. It is the weakness or giving way of these bands which favours the hernial protrusion. The inner pillar of the ring is flat and riband-shaped, whilst the outer is sickle-shaped and thick, and upon it the cord or round ligament rests. Beneath the aponeurosis of the external oblique is a cellular interval separating it from the muscular fibres of the internal oblique, and the *conjoined tendon* of this muscle and the transversalis, this latter passing in front of the rectus and pyramidalis to the linea alba and pubes: blended with the lower fibres of the internal oblique and transversalis are the fibres of the cremaster muscle, on which the ilio-inguinal nerve lies. Beneath the internal oblique is a second cellular layer separating this muscle from the fibres of the transversalis, which forms an arch over the cord, and beneath this arch is the spout-like prolongation of the transversalis fascia (*the infundibuliform*) investing it. Behind the transversalis and the rectus is the transversalis fascia, closely lining them, and here forming with the subperitoneal aponeurosis the posterior layer of the sheath of the latter muscle; in its lower fourth it is attached to the under surface of the crural arch, becoming continuous with the fascia iliaca. Beneath this fascia is the parietal layer of the peritoneum.

The position of the *deep epigastric vessels* can be easily seen, lying beneath the transversalis fascia and the peritoneum, and passing obliquely upwards and inwards, to gain the under surface of the rectus at about its lower third, and internal to the cord.

Before describing the inguinal canal, we must obtain a correct idea of the disposition of the peritoneum, and its method of application to the posterior aspect of the *region, where* we observe the three *fossettes* which play *so important a rôle* in the relations of inguinal hernia.

These may be considered as external, middle, and internal. On examining the internal aspect of the region, it will be noticed that there are several struc-

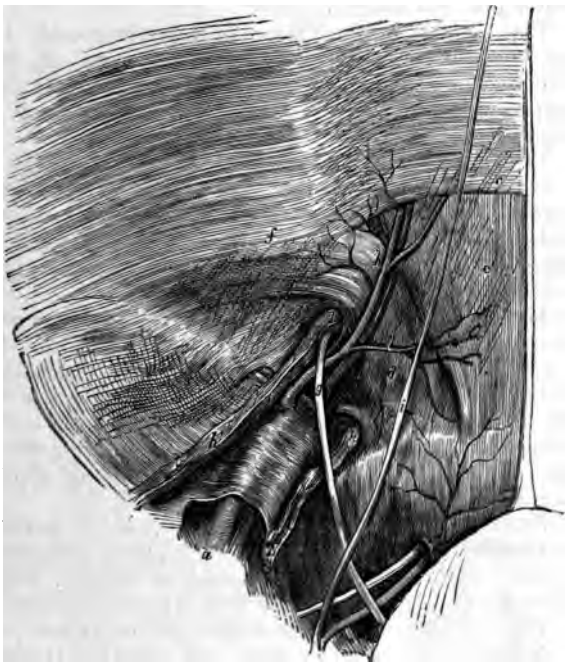


Fig. 44.—Dissection of the Lower Part of the Abdominal Wall from within, the peritoneum having been removed.

a, external iliac artery; *b*, epigastric artery; *c*, border of the posterior part of the sheath of the rectus (fold of Douglas); *d*, conjoined tendon in the triangle of Hesselbach; *e*, posterior surface of rectus; *f*, fascia transversalis; *g*, vas deferens; *h*, spermatic vessels; *i*, obliterated hypogastric artery; *k*, lymphatics in crural rings; *l*, internal abdominal ring.

tures lying beneath the peritoneum, which raise it, and they are the epigastric artery, the obliterated

umbilical artery, and the urachus, whilst between thes are the fossæ above mentioned, and they correspon to the two orifices of the inguinal canal, the interna abdominal and external rings.

The internal fossette (supra-pubic) corresponds t the space between the symphysis and spine of th pubis. The external is the larger and deeper, and th peritoneum may be most readily stripped off, displa ing the cord, which lies inferiorly and internally.

The position of the *internal abdominal* ring recognized as a dimple-like depression in the pe toneum, indicating the closure of its vaginal proce Below this is a furrow showing the position of Poupar ligament, and below this again a depression over t crural ring.

The cords of the obliterated hypogastric arteries a seen as ridges, passing upwards towards the umbilicu forming the margins of the superior false ligamen of the bladder, and between them lie the remains the urachus. Beneath the peritoneum is seen the loo subperitoneal fascia, in which lie the deep epigastr and circumflex ilii vessels, the latter running alo the deep surface of the crural arch.

Parts concerned in inguinal hernia.—Inguinal hern is described as being oblique or direct, with referen to the inguinal canal; and external or internal, wit reference to its position to the deep epigastric vessels.

The *inguinal canal* is an oblique channel, about a inch and a half long in the male, and about two inch in the female, owing to the greater breadth of t pelvis, and its openings are the internal and extern abdominal rings; *the relation of the internal or de ring to the surface* is indicated by a point take about half or three-quarters of an inch above t centre of Poupart's ligament, along a line at rig angles to it. This internal ring is an oval openi in the fascia transversalis, transmitting the cord *the male* and the round ligament in the female, a *is bounded* above and externally by the arched fib

the transversalis muscle, and internally by the epigastric vessels.

Fig. 45.—Dissection of the Inguinal Canal.
External oblique (turned down); *b*, *b*, internal oblique; *c*, transversalis; *d*, conjoined tendon; *e*, rectus abdominis, with sheath opened; *f*, fascia transversalis; *g*, triangular fascia; cremaster; *i*, infundibular fascia.

The boundaries of the inguinal canal are—In front, integument *and superficial* fascia, the aponeurosis *of external oblique, the* internal oblique for its outer

third, and a small portion of the cremaster. *Behind*, the conjoined tendon, triangular fascia, transversalis fascia, subperitoneal fat, and peritoneum. *Above*, the fibres of the internal oblique and transversalis; and *below*, Poupart's ligament and the fascia transversalis.

Oblique or external inguinal hernia follows the course of the spermatic cord or round ligament, passing through both rings.

The coverings of an oblique inguinal hernia are the same as those of the cord—viz., from without inwards:—(1) Integument. (2) Superficial fascia. (3) Inter-columnar fascia. (4) Cremaster muscle. (5) Infundibuliform fascia. (6) Subserous cellular tissue. (7) Peritoneum (*sac*). If the intestine passes into the scrotum, it is called *complete;* if retained in the canal, *incomplete*, or *bubonocele*.

In cases of strangulation, the constriction is caused by some portion of either of the rings, or if in the canal, by the fibres of the internal oblique or transversalis, and any incision for the relief of the stricture should be made *upwards*, to avoid wounding the deep epigastric vessels or spermatic cord, which in this form of hernia lie—the former to the inside of the neck of the sac, and the latter directly behind it.

Varieties.—Oblique inguinal hernia is liable to varieties, known as congenital, infantile, and encysted. In the *congenital* form the pouch of peritoneum which accompanies the cord and testis in its descent during fœtal life remains patent, and the gut falls into this pouch, and thus lies in contact with the testicle. (In congenital hydrocele the condition of the parts is the same.)

In the *infantile* form, the peritoneal pouch is only partially obliterated, and the sac descends along the inguinal canal into the scrotum, behind the pouch; hence there are three layers of peritoneum in front of the gut and its proper investment—viz., two of the *tunica* vaginalis testis, and the sac itself.

Direct or internal inguinal hernia differs in its

e from oblique, in not passing through the inner but through the space known as the triangle of elbach, the boundaries of which are—*externally*, pigastric artery ; *internally*, the outer edge of the s, and *inferiorly*, Poupart's ligament. This is filled in on its inner two-thirds by the con- d tendon, and for the rest by the fascia trans- lis. Any hernial protrusion through this interval emerging from the external ring, would have the

Fig. 46.

Diagram of a congenital hernia, the sac being continuous with the tunica vaginalis testis.

Fig. 47.

Diagram of an infantile hernia, showing the tunica vaginalis prolonged in front of the sac.

epigastric artery external to its sac, and the sper- c cord internal and posterior. This form of re may either force its way through the con- d tendon, or push it before it.

verings of direct inguinal hernia.—The same as already given in the case of the oblique variety, the exception that the conjoined tendon takes lace of the cremaster, the infundibuliform fascia replaced by that portion of the fascia trans- lis behind or immediately contiguous to the ined *tendon.*

The seat of stricture, in strangulation, is either at neck of the sac, at the external ring, or is due to fissured edges of the conjoined tendon. The inc for its relief is to be made *upwards*.

The parts divided in operation for strangu inguinal hernia would be those between the outer and the gut, and the sac, if so indicated by nature of the case, and when reached, the constri itself.

Structures to be avoided.—The deep epigastric ve and the cord.

The *position of the deep epigastric artery with re to the abdominal parietes* is pretty much that of superficial epigastric vessels seen beneath the int ments, and its course is indicated by a line d from a point a little internal to the centre of Pou ligament to about the midde of the space between umbilicus and symphysis pubis.

SURGICAL ANATOMY OF THE CRURAL REGIO

In works on Descriptive Anatomy this regio generally described and dissected as belonging to lower limb; but as its surgical relations essent concern those of the contents of the abdomen, and has so many points in common with it, besides l ing, by its deep aspect, part of the abdominal par it has been thought advisable to introduce it here, to refer back to it again when describing the sup femoral region.*

The boundaries of this region are—*above*, the c arch; *externally*, a line passing from the anterior spine to the trochanter major; *internally*, the p nence of the adductor longus; and *below*, a line d through the point of meeting of the sartorius adductors. These several muscular eminences en

* This plan has been adopted by Malgaigne, and latter *Tillaux*, and seems to the Author the most natural.

an irregular triangular space, sloping towards the centre, in which lie the common femoral vessels; it is the seat of crural or femoral hernia, which appears at the inner and upper part.

Topography.—Beneath the skin is the superficial layer of superficial fascia, continuous with that over the abdomen, containing a good deal of fat, in which lie the superficial circumflexa ilii, epigastric and external pudic vessels; filaments from the external, internal, and middle cutaneous, crural and ilio-inguinal nerves, lymphatic glands, and ducts. It will be noticed that the lymphatic ganglia in the axis of the thigh are those which become enlarged in ulcers or injuries of the lower limb, whilst the upper series, which lies in the fold of the groin, receive the lymphatics of the genital organs, and become affected in venereal complaints. Below this layer is the deep portion of the superficial fascia attached to Poupart's ligament, and to the margins of the saphenous opening, forming a spout-like prolongation over the internal saphena vein as it lies in this opening. That portion of the superficial fascia which closes in the saphenic opening, is called the *cribriform* fascia, from its numerous perforations, due to the passage of lymphatic ducts and the superficial vessels already named. The *fascia lata* is next seen, a dense aponeurotic structure, attached by an outer or iliac portion to the crest and anterior spine of the ilium; and blended with the lower edge of Poupart's ligament to the spine of the pubes and the ilio-pectineal line, where it unites with Gimbernat's ligament. This portion of the fascia lata forms a falciform process, which passes in front of the sheath of the vessels, and is the outer pillar of the saphenic opening. The inner portion, or pubic, is attached along the inferior outlet of the pelvis, and is there connected with the perineal fasciæ and penis, and passing behind the femoral vessels, becomes attached to the ilio-pectineal line, being thus connected with Gimbernat's

ligament, the falciform process of the iliac port fascia iliaca, and the capsule of the hip-joint through this opening that the internal saphe passes to join the common femoral vein.

The crural canal.—Below the fascia lata i along Poupart's ligament is the anterior layer *sheath of the vessels*, a process of the fascia t salis emerging from beneath the crural arcl

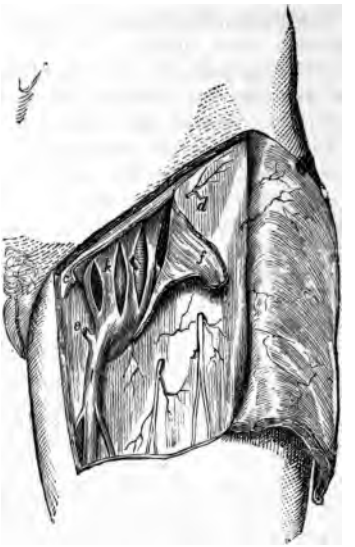


Fig. 48.—Crural Sheath laid open.

a, middle cutaneous nerve; *c*, placed to the inner sid bernat's ligament; *d*, iliac portion of fascia lata; portion of fascia lata; *f*, margin of saphenous openi back); *k*, femoral sheath opened by three incisions; vein.

posterior portion of this sheath is formed by t iliaca, and it will be seen that it occupies *between* the psoas muscle and Gimbernat's

crural arch be pulled upwards a dense band
es will be seen connecting the upper layer of
ɜath with the crural arch, and reaching from the
to Gimbernat's ligament and the conjoined
. This is the *deep crural arch.* The sheath
ded into three compartments, separated by dis-
processes. The inner compartment is termed
ɪral canal. The interval between the femoral
its compartment and the curved edge of Gim-
s ligament is the *crural ring,* the other boundaries
ɔh are—*above,* the deep crural arch; *behind,* ilio-
al line, origin of pectineus, and attachment of
portion of fascia lata. On passing the finger
e crural ring the inferior portion of Gimbernat's
ɪt can be felt along the ilio-pectineal line, con-
ly behind the ring. The crural ring is blocked
ɾe by a thin fascia derived from the subperito-
rmed the *septum crurale,* which transmits ducts
ɪds. The crural canal is usually occupied by a
ɪtic gland.

ɪe employment of *taxis,* for the reduction of a
ɪernia, it must be remembered that the direction
ɜrural canal is *downwards,* and slightly *forwards*
ɪwards; moreover, that, in order to relax the
of this canal, the thigh must be flexed upon
vis, adducted and rotated inwards.

course taken by a crural hernia is as follows:—
ɔassing into the femoral ring, it descends ver-
in the femoral canal as far as the saphenic
ɜ; next, being here prevented from passing
along the sheath of the vessels, it is directed
ls, and subsequently upwards, upon the external
f the opening and Poupart's ligament.

coverings of a crural hernia are—sac, subserous
tissue, septum crurale, sheath of vessels, cribri-
scia, superficial fascia, and integuments.

seat of stricture may either be the sac itself, or
ɪction of the falciform process, with Gimbernat's
ɪt, or the outer margin of the opening; and in

dividing the obstruction, the incision is to be m
upwards and *inwards*.

An irregular course of the *obturator artery* bear
very important relation
the crural ring, should
arise by a common tr
with the deep epigastric,
when it would course al
the border of Gimbern
ligament, in order to
the thyroid foramen.
this case the neck of
hernia would be surroun
by an arterial ring, an
an operation for the r
of strangulation, might
great risk of being woun
Practically, however,
would probably recede,
less the knife were roug
pushed past the posterior aspect of the ring.

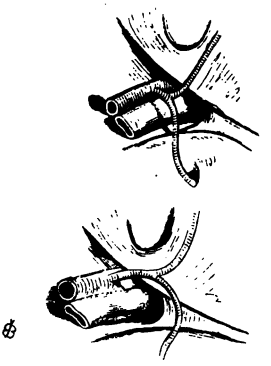


Fig. 49.—Irregular course of Obturator Artery.

Besides herniæ, the fold of the groin is the seat
other *tumours*, of which
accurate knowledge of the
tomy of the region affo
the chief help towards
diagnosis; such as aneuri
the pointing of a psoas abs
an inflamed lymphatic gla
cysts, enlargement of the bu
beneath the tendon of the ps
which is often connected w
the hip-joint.

Fig. 50.—Sketch of Artificial Anus.

1, mesentery; 2, eperon; 3, opening of artificial anus.

Artificial Anus.—In cases
strangulated hernia, whet
inguinal or crural, when
bowel has become gangren
or if the intestine has been wounded, and given
in a state of gangrene, surgical principles indicate

removal of this portion, and the subsequent formation of an artificial anus, and the following condition generally results, which explains the impediments in the way of its healing:—The edges of the gut become attached to the aperture in the abdominal wall, and that generally at an angle which soon becomes acute. As the upper portion of the intestine only transmits fæces, the lower remains as a useless tube, and consequently contracts in its calibre. That portion of the bowel to which the mesentery is attached, becomes drawn out into a spur-like process (*éperon*); which acting as a valve, serves to direct the fæces out of the body, and to divert them from their proper channel.

SURGICAL ANATOMY OF THE ILIAC FOSSA.

POSTERIOR WALL OF ABDOMEN.

The iliac fossa forms the inner aspect of the region just described, and is of great surgical interest. From before backwards the structures successively met with are—the peritoneum, with the viscera it encloses, the subperitoneal fat and cellular tissue, which contains a considerable amount of fat (allowing the peritoneum to be readily stripped off in ligature of the vessels), the common and external iliac arteries and their veins, lymphatics, the spermatic or ovarian vessels, the ureters, and the fascia iliaca. Beneath the fascia is a second cellulo-adipose layer, in which are the circumflex ilii artery and veins, the iliacus and psoas muscles, in the substance of which is the anterior crural nerve; upon the former muscle are seen the external cutaneous and the ilio-inguinal, and upon the latter the genito-crural nerves, and the nutrient vessels derived from the ilio-lumbar, finally the bone.

Fascia iliaca.—This structure is of the utmost importance surgically, as affecting collections of fluid in the region. It may be regarded as a continuation of the *fascia transversalis*, it is very dense and tough, and

by its attachment converts the iliac fossa into fibrous compartment. It is attached anteri externally to the crest of the ilium and Poup ment, and behind this it is attached to the oblique and transversalis. Posteriorly and int is attached to the superior outlet of the pelvis behind the vessels and forming a kind of cellul Superiorly it is attached to the inner lip of crest, to the ilio-lumbar ligament, and is cc with the aponeurosis which covers the (lumborum. Inferiorly, just above the crura divides into five laminæ, the anterior becon tinuous with the transversalis fascia, and the forming the aperture through which passes psoas muscle.

The peritoneum is very loosely united to the tissues. It completely invests the left iliac f the right incompletely, on account of the p the cœcum. The subperitoneal cellular tissu lax, and contains a considerable amount of continuous with that of the abdomen, and i quent seat of abscess of various kinds, eff blood, or urine. Pus developing in this tissu its limits the fascia transversalis in front, iliac behind, and Poupart's ligament below up the peritoneum it may, however, pass course of the vessels.

Vessels.—The common iliac.—The course this vessel, with regard to the surface of th from a point just to the left of the umbilic centre of Poupart's ligament. After the and peritoneum have been raised, it will that the aorta bifurcates, or does generall left side of the fourth lumbar vertebr quently the vessels of the right and left s somewhat in length, the right being sli longer, and lies rather more obliquely a body of the fifth lumbar vertebra. Their ***about two* inches,** more or less, and passing d

and outwards, at the sacro-iliac synchondrosis divide into external and internal iliacs; the vena cava inferior lying to the right side, and being formed by the union of the two common iliac veins, the right common iliac artery crosses their junction, rendering the relation of the vessels on the right side more intimate, the vein projecting external to the artery above, and being internal to it below, whilst on the left side the vein lies below and internal to its artery. Both are crossed at their bifurcation by the ureter.

The relations of the common iliac of the *right* side:—In *front* of it, the peritoneum, ilium, sympathetic plexus, and ureter; *externally*, the cava, right common iliac vein, psoas magnus; *behind*, junction of common iliac veins, obturator nerve. On the *left* side it has, in *front*, peritoneum, sympathetic, rectum, inferior mesenteric artery, ureter; *externally*, psoas magnus; *internally*, left common iliac vein; *behind*, left common iliac vein, obturator nerve.

Ligature of common iliac artery.—In order to reach this vessel a curved incision is recommended, commencing from just above the middle of Poupart's ligament to a point two or three inches above and to the inner side of the anterior superior spine, or, commencing from a point close to the anterior superior spine, towards the edge of the rectus. The first incision divides the integuments; next the external oblique, the internal oblique, and the transversalis are to be divided in succession and to an equal extent. Beneath this latter is the transversalis fascia, which is to be carefully pinched up, nicked, and a director insinuated between it and the peritoneum. It is then to be divided to the length of the incision in the muscles (the deep circumflex iliac artery will stand a chance of being cut). The peritoneal bag and its contents are to be then pulled away towards the middle line, when the vessel will be seen just above the sacro-iliac synchondrosis. The needle is to be passed from within *outwards*.

The collateral circulation would be maintained by the inosculation of the lateral sacral and middle sacral, epigastric and internal mammary, aortic inter-costals and lumbar, the ilio-lumbar and last lumbar, the obturator, with its fellow of the opposite side, and the epigastric, gluteal, and sacral, hæmorrhoidal of the internal iliac, with the superior hæmorrhoidal of the inferior mesenteric, and the vesical of the opposite sides, and the uterine and ovarian in the female.

The external iliac artery.—The course of this vessel would be indicated on the surface of the body by a line extending from either side of the umbilicus to the centre of Poupart's ligament. It commences at the bifurcation of the common iliac, and extends to the crural arch, where it becomes common femoral.

Its relations are—in *front*, intestines and peritoneum, a considerable quantity of loose areolar tissue, the spermatic vessels, the genito-crural nerve (near Poupart's ligament), the circumflexa ilii vein, and a chain of lymphatics; *externally*, the psoas muscle, and fascia iliaca; *internally*, the external iliac vein, vas deferens, and lymphatics; *behind*, the external iliac vein and psoas magnus muscle.

Ligature of external iliac.—An incision (curved for preference) is to be made, commencing at the middle of Poupart's ligament, and at about an inch above it, to a point just beyond the anterior superior spine of the ilium. The structures divided and the method of dividing them are those described in ligature of the common iliac, with this exception, that here they are more aponeurotic, from being nearer Poupart's ligament; and the deep epigastric artery is in this instance in danger of division, if the incision be made too near the rectus muscle.

When the peritoneum and intestines have been pulled away from the point where the ligature is to be applied, it often happens that neither artery nor vein is to be found; in this case they have followed these structures, and will be discovered lying adherent

to the under surface of the peritoneal bag, with the ureter, from which they must be cautiously separated. The needle is to be applied *from within outwards.*

Collateral circulation after ligature of external iliac.—The gluteal anastomoses with the external circumflex from the profunda femoris; the ilio-lumbar, with the circumflexa ilii; the obturator, with the internal circumflex from the profunda; the ischiatic, with the perforating and circumflex branches of the profunda; the internal pudic, with the superficial and deep external pudic, and the internal circumflex from the profunda; and the deep epigastric with the superior epigastric from the internal mammary.

Beneath the fascia iliaca is a second cellulo-fatty layer, which is associated with the tendon of the iliaco-psoas, as far as its insertion, and pus forming therein would pass beneath the crural arch external to the vessels, and point at the internal and superior portion of the thigh, at the level of the small trochanter.

SURGICAL ANATOMY OF THE LUMBAR REGION.

The lumbar region forms the posterior portion of the abdominal parietes, and is of surgical importance from the relation to its anterior aspect of the abdominal viscera, from the numerous fasciæ which enter into its formation, and the relation of these fasciæ to abscess, the operation of colotomy, nephrotomy, the opening of peri-nephritic abscess, etc.

The limits or boundaries of the region may be defined as follows:—*above*, the lower border of the last rib; *below*, the crest of the ilium; *externally*, a line drawn through the end of the last rib perpendicularly to the iliac crest; and *internally*, the line of the spinous processes of the vertebræ.

Topography.—The integument is tough and thick; the subcutaneous cellular tissue contains a great deal of fat, excepting along the middle line. We next see, in order, *from without inwards*, the following structures:

the aponeurotic origin of the latissimus dorsi and serratus posticus inferior, part of the external oblique, and common aponeurotic attachment of the internal oblique and transversalis, the mass of the erector spinæ muscles, a considerable number of vessels and nerves lying between these muscles, the attachment to the transverse processes of the lumbar vertebræ of the middle lamina of the aponeurosis of the transversalis muscle, the quadratus lumborum muscle and ilio-lumbar ligament, branches of the lower part of the dorsal and upper part of lumbar plexuses, psoas muscles, transversalis fascia, a large quantity of fat and cellular tissue separating the kidney from the parietes, the kidney itself, with the ureter and spermatic or ovarian vessels, and in the front of the psoas, the colon, the ascending on the right, and the descending on the left. The ascending colon is generally enclosed in peritoneum, which forms, by its attachment to the spine, a mesocolon, whilst the descending is covered only anteriorly and laterally, and is for that reason selected for the operation of opening the colon in the left loin (Amussat).

"The descending colon has fixed positions, and being incompletely invested by peritoneum, an incision can be made into it without wounding this membrane. It is usually stated that the descending colon lies along the outer border of the quadratus lumborum, and in conformity with this, an incision is to be made vertically along the outer border of this muscle. This is not always correct. At the lower border of the kidney, the colon lies further away from the middle line than it does in the iliac region; and the quadratus lumborum being narrower above than below, this rule is true as far as regards the position of the gut at the level of the third lumbar vertebra, but not so beyond this point. At the level of the symphysis between the third and fourth lumbar vertebræ, and *at that of the* fourth below the kidney—and *therefore exactly in* the field of operation—the quad-

us lumborum covers in the colon posteriorly, and
st be cut in order to reach it. It is only when
turbed, a condition which is not so constant as
would expect in operations, that the intestine
reases in breadth forwards and outwards, or over-
s the outer border of this muscle (Pirogoff).
nsequently the incision which is to be directed
ng the border of the great extensors of the trunk
m the ilium to the twelfth rib, would divide the
ong tendon of the transversalis until the quadratus
exposed, and subsequently the fibres of this
uscle, when the extra-peritoneal fat and cellular
sue would be met with. When the surgeon has
refully arrived at the cellulo-fatty tissue through the
scia beneath the quadratus lumborum, making the
cision of an equal length with the primary one, so
to avoid a funnel-shaped wound, the main point is
fix the colon at its free surface, and open it. In
ing so he must avoid the kidney, which from its
ep position can easily obstruct the field of opera-
n, and which must be carefully pushed on one side.
om the impossibility of recognizing the peritoneum
m its posterior aspect, success can only be cal-
ated on by measuring the distance of the point of
ection of the peritoneum, and how far from the
on this position is constant. In the first place, as
ards the descending colon which is here particularly
erred to, after measurements on frozen bodies of full-
wn men, it would seem that this distance, in a straight
(therefore not corresponding with the curvature of
wall of the intestine) is from four-fifths of an inch to
inch, supposing the intestine empty and con-
cted (at a level between the third and fourth
mbar vertebræ;) further, that the free side of the
estine, as in the accompanying cut, does not look
teriorly but somewhat inwards, exactly towards
angle which the psoas and quadratus lumborum
ke with each other. If on the other hand, the
ll *intestines are much* distended, the peritoneum

between the psoas and the colon would be pushed further downwards, and the colon, by means of the traction of the parietal portion of the peritoneum, would be rotated in its axis, so that its free surface would be dissected more outwardly. Should the

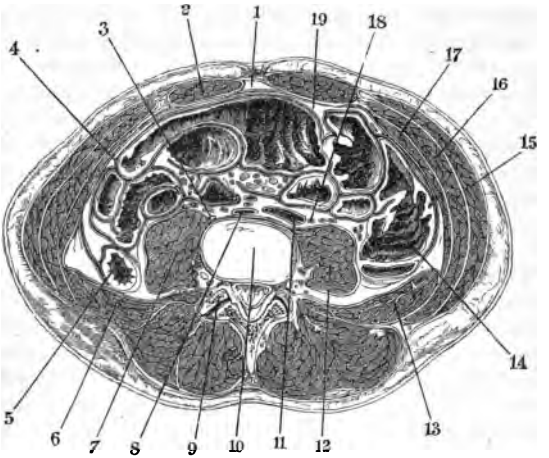


Fig. 51.—Section of Abdomen between the third and fourth lumbar vertebræ.

1, umbilicus; 2, rectus; 3, sympathetic (note); 4, great membrane; 5, descending colon; 6, quadratus lumborum; 7, psoas; 8, aorta; 9, articular process of third lumbar vein; 10, inter-articular cartilage; 11, vena cava; 12, psoas; 13, quadratus; 14, ascending colon; 15, external oblique; 16, internal oblique; 17, transversalis; 18, ureter; 19, great omentum.

colon itself be distended, its surface free of peritoneum becomes considerably larger, and may assume a breadth of from 2 to $2\frac{2}{5}$ inches. Tympanitis of the smaller intestine appears to have a rotatory influence on the distended colon." *

* *I have transcribed* this passage from my own translation of *Braune's* "*Topographical* Anatomy," on account of its great *practical value.*—E. B.

Lumbar colotomy.—The colon may be reached her by a transverse incision (Amussat), by a longi- linal one (Hilton, Callisen), or, better still, by an ique one.

Structures divided in Amussat's operation by trans- se incision.—The incision is made from a point en midway between the crest of the ilium and last rib at the outer edge of the erector spinæ, ying in length according to the development of the ividual, and is directed outwards, at first dividing integuments, the aponeurotic origin of the latis- us dorsi, and some few fibres of the external ique; next the origin of the internal oblique and nsversalis, and a portion of the quadratus lum- um and its fascial investment. After the trans- salis fascia has been divided, a quantity of loose ular tissue and fat is seen, which, being scratched ough, exposes the colon. During life, however, the ension is generally so great that the bowel *bulges*) the wound.

n the vertical incision, which is made about four hes or so external to the spinous processes of the tebræ, the structures divided would be, the integu- nt, the aponeurotic origin of the latissimus dorsi, origin of the internal oblique, tendon, transversalis transversalis fascia.

hat portion of the spinal column which is en- ed between these regions, has upon its anterior face the crura of the diaphragm, covered by itoneum and subperitoneal fat and fascia, the vena a ascendens, abdominal aorta, and on either side chain of the sympathetic, the thoracic duct, the ptaculum chyli, vena azygos major, and a large nber of lymphatic glands.

Lumbar fascia.—The peculiar arrangement of the ciæ in the lumbar region is of great importance gically, from the control it has over the course en by the pus in lumbar abscess. This fascia is *posterior aponeurotic* portion of the transversalis,

and posteriorly gives attachment to the internal and external oblique and latissimus dorsi muscles. From its inner edge, two laminæ, derived from it, are attached to the transverse processes of the lumbar vertebræ, and enclose the quadratus lumborum, the posterior lamina separating it from the erector spinæ, whilst the posterior portion of the erector spinæ is covered in by the aponeurosis of the latissimus dorsi.

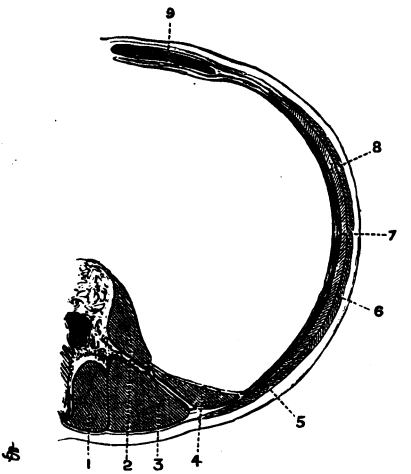


Fig. 52.—Arrangement of Lumbar Aponeurosis at level of third lumbar vertebra.

1, sacro-lumbalis; 2, psoas magnus; 3, longissimus dorsi; 4, quadratus lumborum; 5, latissimus dorsi; 6, external oblique; 7, internal oblique; 8, transversalis; 9, rectus.

In the condition known as "lumbar abscess," the passage of pus is governed by the lumbar aponeurosis, and by such laminæ of fasciæ as spring originally from it, and may extend anteriorly in the cellular interspaces between the abdominal muscles, or posteriorly

. those of the lumbar muscles and their
ves.
. cases such abscesses point *above* the level of
's ligament anteriorly, *above* the iliac crest
, and *above* the lumbo-sacral sulcus posteriorly,
h of course they may perforate the parietal
ium. This, however, is rare.
ctions of pus may originally form in the
compartment of the lumbar aponeurosis, and
e forwards and downwards, directed by the
ransversalis to the edge of the rectus, on the
the fold of Douglas. This lamina of fascia
salis would separate the collection of pus from
e known as the cavum præperitoniale, the so-
ssa of Retzius.
ous cannot pass to the opposite side, owing to
tral concurrence of all these fasciæ, and its
forwards is easily explained if we regard the
salis fasciæ and the intermuscular cellular
as derivatives of the lumbar fascia anteriorly.
e diagnosis of the locality of pus, whether in
or behind the fascia transversalis, depends on
aviour of the "respiration line," and the fact of
confined to one side.
esses developed in the posterior compartment of
ibar aponeurosis may point anteriorly at first
the peritoneal cavity, and subsequently make
ay to the surface posteriorly, or when developed
the sheath of the quadratus point at its pos-
id external border where the abdominal parietes
weak (triangle of Petit).
ess simulating "lumbar" may be associated
carious condition of the rib, the pus being
posteriorly by the sheath of the sacro-lumbalis,
avitating downwards in the posterior com-
it of the lumbar fascia.
ough the psoas muscles essentially belong to
ibar region, *yet psoas abscesses do not neces-
rise in them, the course taken by the pus being*

in a great measure governed by the fascial investment they obtain there; this investment is that of the fascia iliaca, which, as regards the muscles, is attached above to the ligamenta arcuata interna, internally to the sacrum, being continued over the muscles to the crural arches, beneath which the pus gravitates, and ultimately points *external* to the femoral vessels. Sometimes it passes through the sacro-sciatic notch to the nates.

The relation of the nerves to the spinal column, emerging as they do either through the intervertebral spaces or sacral foramina, readily accounts for the course taken by the pus in these abscesses.

Iliac abscess is a collection of matter either in the cellular tissue, between the iliac fascia and peritoneum, or between the fascia iliaca and iliacus muscle, and points above Poupart's ligament, near the anterior superior spinous process of the ilium.

The collections of pus met with beneath the peritoneum (peri-and retro-peritoneal) are usually dependent on inflammatory conditions of those viscera which are enveloped in that "atmosphere" of cellular tissue, the various spaces of which may be examined, at all events, theoretically, in the following manner, as originally suggested by Koenig. We may obtain a tolerably good idea of the behaviour of pus with regard to the fasciæ and pelvic peritoneum by *injecting* these cellular interspaces.

First, to demonstrate the probable course of the pus in a subserous (or *supra*-fascial) abscess of the iliac fossa. If an injection-tube be introduced at the edge of the true pelvis at the highest portion of the broad ligament, between the two layers, the peritoneum is immediately lifted off the iliacus and psoas, and then detaches itself from the anterior wall of the abdomen. Some of the fluid may pass into the inguinal canal, or along the sheath of the vessels. In the male, merely *introducing* the tube beneath the peritoneum will *suffice, and* the fluid often makes its way along the

course of the cord, as does pus in some forms of abscess. Again, with regard to *sub*fascial abscesses, if the inner aspect of the psoas muscle be injected beneath Poupart's ligament, the fluid passes immediately into the region of the vessels and psoas itself; and on applying a little more pressure it passes into the sheath of this muscle, or between the bundles of muscular fibre, as high as the lumbar vertebræ, while a still greater amount causes it to extend as far as the quadratus, whilst it simultaneously fills the iliacus muscle and its fossa. If the injection be introduced on the outer aspect of the iliaco-psoas tendon, it fills up the entire space enclosed by the fascia iliaca and the ilium; a little more pressure will drive it into the psoas.

Next it rises up to the quadratus, and ultimately reaches the zone of cellular tissue surrounding the kidney. When the iliac fossa is full, the contents of the osseo-aponeurotic cavity drag up the peritoneum from Poupart's ligament, and may be felt bulging near the anterior superior spinous process.*

The "pointing" of these abscesses, however, is liable to variation. It may be detected (1) at the outer edge of the quadratus; (2) it may become associated with the psoas tendon, or pass through the ischiatic foramen; (3) it may involve the hip-joint through the bursa iliaca; (4) it most frequently passes beneath Poupart's ligament at the outer aspect of the iliaco-psoas tendon, reaching the surface by the cellular interspace between the rectus femoris and the tensor fasciæ, or it may follow the inner edge of the rectus, and point in the region of the sheath of the sartorius.

Owing to openings in the fascia, such as for the passage of nerves or blood-vessels, or irregularities in its application, the subserous abscess may become subfascial, or the converse, or they may be co-existent.

Sacro-iliac disease.—With regard to the passage of pus in this disease, it may either make its way to the surface at the superior portion of the articulation or on

* *Koenig*, "*Lehrb.* der Spec. Chirurg.," Bd. ii.

the outer aspect of the thigh, or a little behind the great trochanter, taking the course of the great sciatic nerve—the course depending on the relation the sacro-iliac joint bears to the lumbo-sacral cord, and the strong lamina of pelvic fascia which covers in the pyriformis muscle. Sacro-iliac abscesses may point on the inner side of the thigh at the edge of the obturator externus, following the course of the obturator vessels and nerve.

Unlike lumbar abscesses, which may be palpated in some cases both anteriorly and posteriorly, or the fluid made to pass from one fascial envelope to a communicating one, if two collections of matter exist, one cannot be emptied into the other, on account of the peculiar serrated shape of the articulation.*

SURGICAL ANATOMY OF THE PELVIS.

Those portions of the true pelvis and its contents which come within the province of the surgeon are, more particularly, the genito-urinary apparatus of both sexes, the rectum, and its inferior boundary, comprising the perineal and anal regions. Those details of its anatomy which more particularly concern gynæcology will be studied with greater advantage in special works upon the subject, and will be but briefly alluded to here.

Its walls present surgically two surfaces for examination, on either of which operative proceedings may be instituted—(1) An *external*, partly free, consisting inferiorly of the perineum, laterally of a region belonging partially to the lower limb, and posteriorly, of the sacral and coccygeal regions; and (2) an *internal*, consisting of the peritoneal surface of the perineum, and the soft parts lining its bony structure, which include the pelvic viscera and the great vessels.

The external genitals may be regarded as appendages to the pelvis, and will be conveniently treated of

* *Vide Clin. Lect.* by Author, *Med. Times and Gaz.*, July 12, 1879.

fore entering upon its immediate anatomy, and such rts of its lateral boundaries as are evidently common it and to the lower limb will be included in the scription of the latter.

PELVI-PERINEAL REGION.

SCROTUM.

Structure.—The various tissues entering into the ructure of the scrotum are met with in the following der:—The *skin*, very thin, lax, and rugose; the *perficial fascia*, with which it is closely associated, ntinuous with that covering the abdomen and perieum, and in this region entirely destitute of fat. he *dartos*, consisting of loose areolar tissue, in which a considerable amount of unstriped muscular fibre, ery vascular, is continuous with the superficial fascia of he crural region and perineum, and sends a septum inwards which divides the scrotal bag into two halves, thus separating the testes. The dartos is connected with the subjacent parts by delicate areolar tissue, allowing of the free movement of the scrotal structures over the testes, and owing to the corrugating power it has over the scrotal tissues, it is difficult to approximate the edges of incisions when made in its structure. A *fibro-cellular* coat has been described, which is the continuation of the external spermatic fascia, but it is very thin, and not easily followed beyond the cord. Beneath this layer is the *cremasteric fascia*, derived from the lower border of the internal oblique and gubernaculum during the descent of the testis, and the *fascia propria* or *infundibuliform*, a derivative of the fascia transversalis. All these structures are interunited by a very lax cellular tissue, which not only allows of their free movement over each other, but over the cord and testes.

The scrotal tissues are not very sensitive, and have not much vitality; consequently, in erysipelatous inflammation or urinary extravasation they rapidly

become gangrenous. When the urethra gives way from unrelieved retention, or from ulceration of its walls, the urine is driven by the sudden contraction of the bladder into the cellular interval between the scrotal and abdominal fasciæ, and its direction is limited by the attachments of the fascia already named. Commencing at first in the scrotum, it ascends over the pubes and abdomen and cellular tissue of penis, but cannot descend down the thighs, owing to the attachment of the deep layer of superficial fascia along Poupart's ligament. In the case of wound of the urethra from without, such, for instance, as a blow in the perineum, not only is the urethral tube itself ruptured, but the fasciæ enveloping it, often to an unlimited extent; hence the urine may follow almost any course, and not restrict itself to anatomical relations.

The *spermatic cord* consists of the external spermatic fascia, cremaster, infundibuliform fascia, vessels, lymphatics, nerves, and the vas deferens, which can be readily isolated from the other structures, being recognized by its whipcord-like texture. The *arteries* of the cord are the spermatic, deferential, and the cremasteric; of these the spermatic supplies the substance of the testis, passing into it either through the tunica albuginea, or through the back of the mediastinum testis. The *veins*, passing from the testis, unite in forming the *pampiniform* plexus, which passes into a single trunk forming in the body of the cord, and terminating, the right one in the vena cava, and the left in the left renal vein.

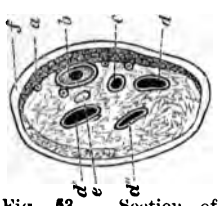


Fig. 53. — Section of Spermatic Cord.

a, cremaster; *b*, vas deferens; *c*, spermatic artery; *d*, spermatic veins; *e*, ilio-inguinal nerve; *f*, external spermatic fascia.

The veins of the cord are very liable to a varicose condition (*varicocele*), which is due to several anatomical causes:—their tortuous arrangement and free

moses at their emergence from the gland; their
of support, lying as they do in the loose areolar
which allows of the weight of the contained
n of blood obliterating their valves; the pressure
receive in their passage through the inguinal
It is a matter of fact that the left spermatic
are almost exclusively liable to this condition,
uses assigned being, that the left testicle hangs
and that its upward current of blood meets
ght angle that proceeding from the kidney in the
nal vein, and that they are liable to constant
re from the contents of the sigmoid flexure of the

lymphatics are numerous and large, and termi-
in the lumbar glands, which become rapidly
d in malignant disease of the testis.
immediate covering of the testis is the tunica
lis—a structure of great surgical importance.
the testis passes into the scrotum, towards the
f intra-uterine life, it carries with it a portion
peritoneum, which envelopes it without com-
y enclosing it with its cavity. It presents a
al and a visceral layer. The former being
d to the internal aspect of the scrotal tissues
brous tissue), and the latter covering the testis
pididymis. The parietal layer is reflected over
st, forming a cul-de-sac, which bulges up higher
ally than internally.
visceral layer keeps the two extremities of the
lymis in contact with the gland and at about
ntre, forming a sort of mesenteric fold, or *meso-*

tunica vaginalis presents three distinct
gations, or pouches, which may be termed
unicular, epididymitic, and testicular, but in
normal condition they are not distended with

ween the parietal and visceral layers there is in
uterine life a canal, so that the tunica vaginalis

communicates with the peritoneal cavity, and it is not until after the completion of the descent of the testicle that this canal becomes obliterated; and the cicatrix of this obliteration is situated just behind the inguinal canal, giving rise to the external inguinal fossette.

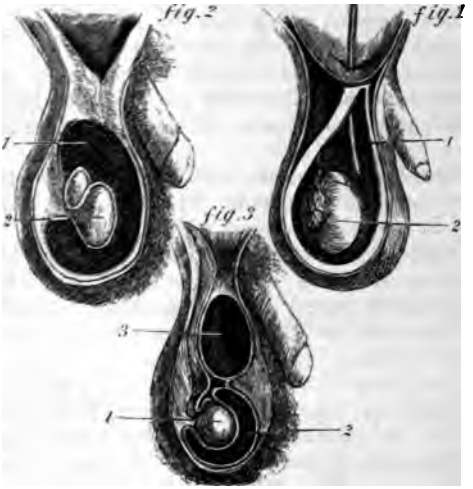


Fig. 54.

Fig. 1, Congenital Hydrocele:—(1), a probe passed through the patent processus vaginalis; (2), testis.
Fig. 2, Hydrocele:—(1), testis; (2), tunica vaginalis.
Fig. 3, Hydrocele of Cord:—(1), testis; (2), tunica vaginalis; (3), processus vaginalis.

Hydrocele.—This consists of a collection of fluid in the scrotum or cord, and is subject to a good many varieties. We may here mention the three following as the most common:—

Congenital hydrocele (Fig. 1), in which the fluid is in the patent canal (processus vaginalis), and is most common in children.

hould the opening of communication with the toneal cavity be large, the fluid sometimes passes k into this cavity, and a knuckle of small intestine pass into the scrotum. (*Vide* "Congenital nia.")

ydrocele of the tunica vaginalis (Fig. 2). This is most common form met with in adults. In condition the testicle is generally situated pos- orly and internally, for the reason that the tunica inalis is of greater capacity anteriorly and ex- ally.

ydrocele of the cord (Fig. 3). This signifies a ection of fluid in this portion of the processus inalis lying with the cord. There are several eties of this form.

n the event of the hydrocele being of long standing, epididymis becomes separated from the body of the is.

he transparency of the hydrocele is not constant, he tunica vaginalis becomes sometimes so thickened, its contents are so altered, that they are quite que.

n *hæmatocele*, the anatomical relations of the testis its covering are precisely similar.

n puncturing the tunica vaginalis and "tapping," the ar should be pushed in at first vertically, with wn, and the canula then directed upwards.

TESTIS.

As the structure of the testis will be found in all ks on descriptive anatomy, it is proposed to make e few remarks, which may have a practical bearing. e testis is ovoid in shape and flattened transversely, l it hangs suspended by the cord, so that the major s is oblique from above downwards, and from before kwards. The *consistence* is firm and equal in *lth, and any indurations* or knots are indications of

a morbid condition. The peculiar pain produced by pressure is often of diagnostic value in determining the position of the organ.

The testis has a special fibrous covering, the tunic albuginea, very resistant, and forming the integral portion of the organ, its inner surface gives off trabeculæ which subdivide the testicular substance into distinct lobules. The greater number of degenerations of the testis commence within these interlobular trabeculæ.

The fibrous envelope yields to gradual, but resists rapid distension, and this is a valuable fact in determining the nature of testicular tumours, as in the instance of sarcoma or encephaloma the distension is gradual, and, at last breaking through at one or more points, the growth protrudes, giving rise to the induration or knots referred to.

It is often difficult in disease to distinguish the testis from the epididymis, a point of importance in diagnosis. To do so, the scrotum should be held firmly grasped by the one hand, and the lateral surfaces of the enclosed testis gently traversed by the index finger of the other backwards and forwards when the furrow which separates the testis from the epididymis may be made out, and the surgeon may detect whether it corresponds with the posterior or anterior border, or to either of the surfaces of the gland, according as the testis is normal or inverted.

In removal of the testis (*castration*), the retraction of the cord into the abdominal cavity, owing to the action of the cremaster muscle, is liable to give trouble through hæmorrhage, unless it be firmly secured.

The *structures divided in the operation of castration* would be as follows:—The scrotal tissues, with the vascular and nervous supply — viz., the superficial perineal vessels and nerves, inferior pudendal nerve, *superficial* external pudic vessels; the structures entering *into* the formation of the cord.

THE MALE PERINEUM.*

This region is best studied when the body is placed in what is known as the lithotomy position—that is, with the legs flexed on the thighs, and the thighs on the pelvis, in order that the parts to be examined be on the stretch.

In the erect position of the body the superficial aspect of the region becomes a mere fold, but it must be borne in mind that the same relations exist.

There is considerable difference in the descriptions given by authors as to what the limits of the perineum really are: some including all those structures which close in the inferior outlet of the pelvis, its entire floor in fact; others dividing this lozenge-shaped space into two triangles, by a line passing from one tuberosity of the ischium to the other, in front of the anus, and calling all in front of it the perineum, and all behind it, the anal, or ischio-rectal region. It is proposed to adopt the latter method in this description, and it will be seen that, although it may appear arbitrary as far as the superficial layer of fascia is concerned, as the examination proceeds deeper towards the inner aspect of the pelvis, the arrangement is a natural one, as adapting itself to the special contents of each triangular space. The boundaries of the anterior portion, which is convex in the middle, owing to the position of the bulb of the urethra, are—below, a line passing horizontally in front of the anus from one tuberosity of the ischium to the other; and laterally, the pubic rami, meeting at the symphysis; thus forming a triangular interspace, which is itself divided by the median raphé

* It has been considered advisable, instead of devoting a special chapter to the surgical anatomy of the female genito-urinary apparatus, to incorporate any facts of surgical importance relating to it in the description of those of the male, and the student is referred to *special works on obstetrics* for detailed descriptions of *these organs, e.g., uterus, ovary*, etc.

into two equal parts, in either of which the lateral operation of lithotomy may be performed. This raphé indicates the course taken by the urethra, and is a most valuable landmark in all operations about the perineum. The sides of this triangular space are about three inches and a half long. its base about three inches, and a line drawn from the apex of the triangle to its base, about three inches.

Topography.—Anterior perineal region.—The integument is here moderately thick, becoming thinner as the fold of the scrotum is approached, and is very distensible and resilient. Beneath is the subcutaneous cellular tissue, which is very adherent to the integument along the middle line. The superficial fascia may be conveniently divided into two layers: the upper containing a good deal of fat (which considerably augments the depth of the perineum in some cases) is continuous with that of the scrotum and thighs, and in it, or immediately beneath it, lie the superficial perineal vessels and nerves, whilst the deeper layer has important attachments and is more membranous in texture. Externally, it is attached to the rami of the pubes and ischium, outside the crura and erectores penis; behind, it is continuous with the deep perineal fascia, or triangular ligament of the perineum, after turning round the transversus perinei; and in front it is continuous with the dartos and fasciæ at the root of the penis; a septum derived from it passes inwards, dividing the posterior part of the space beneath this layer of fascia into two, but is, however, ill defined in front. This cellulo-fatty layer is a favourite seat of abscess from urinary or other infiltrations.

The attachments of this fascia are very important as directing the course of the urine in extravasation, from rupture of the urethra anterior to the triangular ligament, into the cellular tissue of the scrotum and penis.

Along the mesial line this fascia is intimately *attached* to the bulb of the urethra, and in cases where

has been injured, the urine, after extravasa-
dily finds its way along the spongy portion of
hra to the glans, with which it is continuous.
this layer of fascia, in the middle of the space,
cceleratores urinæ muscles, enveloping the bulb,
ither side are the erectores penis, passing from
r aspect of the ascending ramus, and cover-
lower portions of the crura. Lying somewhat
y to the central tendon are the transverse
of the perineum. This central tendon is a
brous knot, and acts as a *point d'appui* for the
or urinæ and external sphincter muscles; it is
in the median line between the urethra and
s. Lying between, and upon the erectores
d the accelerator urinæ, are the trunks of the
al perineal vessels and nerve, and some inoscu-
ranches of the inferior pudendal, and on or
e posterior border of the transversus perinei
lie the transverse perineal vessels and nerve.
elerator urinæ is separated from the deep layer
ficial fascia by a thin aponeurotic layer. This
which compresses the bulb, and empties the
urethra, is generally described as consisting
portions, commencing from the median raphé
terior, which passes round the penis to be
. on its upper aspect, sending an expansion
compresses the dorsal vein; a middle, which
the inferior portion of the urethra, and passes
it and the body of the penis; and a posterior,
is attached to the anterior surface of the tri-
ligament.

ll be observed that the perineal muscles of one
rm a triangular space, having the triangular
t as its floor, while from its outer angle
the superficial perineal vessels, and the
rse perineal vessels and nerves coming to the
; the relations of the space are of importance,
e lateral operation of lithotomy the first incision
s it.

Below the accelerator urinæ muscle is the bulb of the urethra, small in childhood, and large in advanced age, and closely bordering on the margin of the anus; this fact is of importance, as there is a greater danger of wounding the bulb in the lateral operation of lithotomy in old persons. Next is met with the anterior surface of the *triangular ligament*, a tough bluish-white structure—the fibres of which are nearly all transverse—allowing of the structures between the two layers being readily seen through it in favourable subjects; its base is directed towards the rectum, it is attached in the middle line to the central tendon of the perineum, and laterally to the rami of the ischium and pubes, having a free margin on either side of the central tendon, which is continuous with the deep layer of superficial fascia; its apex is directed upwards, and is connected with the periosteum in front of the symphysis pubis. It is perforated at about an inch below the symphysis by the urethra, with which it is intimately connected, and which here changes its direction, and between the urethra and the symphysis lie the vessels and nerves of the penis, the dorsal vein or veins in the centre, on either side the dorsal arteries, and most externally the dorsal nerves. Beneath the triangular ligament is a considerable plexus of veins.

Structures between the layers of the triangular ligament.—These consist of the following:—a plane of muscular fibres, variously described by different authors, as the levator and compressor urethræ, surrounding the membranous portion of the urethra, which lies between these layers of fascia, and receives a prolongation from each; the deep transversus perinei; the internal pudic artery and nerve, the former giving off the artery to the bulb and to Cowper's gland; the artery to the corpus cavernosum, and the dorsal artery of the penis; and just below the urethra, Cowper's glands, their ducts, and the sub-pubic ligament. Beneath this layer of muscular fibres and vessels is the posterior layer

he triangular ligament, derived from the pelvic
a.

he posterior layer of the triangular ligament is
ved from the pelvic fascia, and covers the hinder
of the membranous urethra, and outer surface of
prostate gland ; it is attached below to the anterior
r, forming a pouch on either side of and below the
hra, in which lie Cowper's glands.

eneath it are the anterior fibres of the levator ani,
ing by the sides of the prostate, and uniting on
perineal surface with the muscle of the opposite
, and blending at the central tendon with the fibres
the external sphincter and transverse perineal
cles. The central fibres are inserted into the side
he rectum, interlacing with the sphincters, and the
erior are attached to the coccyx and median raphé
ind the rectum. These muscles and the triangular
ment shut in the inferior outlet of the pelvis.

he anal or ischio-rectal region.—The integument
ere thick, particularly where it is continuous with
of the gluteal region, whilst at the margin of the
s it becomes very thin, and is continuous with the
ous membrane. The muco-cutaneous layer is
wn into a series of folds by the external sphincter
ı which it is incorporated, and the skin of the
le of the perineum posteriorly is interwoven with
cular fibres.

n the middle line of this space lies the anus, the
ous membrane of which does not protrude, in the
nal state, during life. If, however, the anus be
ly opened at the junction of the mucous membrane
ı the skin, a pale line is to be seen, marking the
tion of the internal sphincter, a thickening of the
cular fibres of the lower portion of the rectum.
s band of muscular fibres plays an important part
reventing the healing of ulcers and fissures of the
um, by keeping the tissues on the stretch. These
rs are generally situated about a quarter of an inch
so from the verge, just within the sphincter, and

generally either in front of, or at the side of the coccyx. The treatment consists in dividing the fibres with a view to relieve the tension. In operating on the female, care must be taken in making the incision, if on the anterior wall of the bowel, on account of the proximity of the vagina. If the verge of the anus be carefully examined it will be seen to contain a large number of follicles, in which suppuration often occurs leading to a condition which might be mistaken for fistula—a disease which is frequently difficult to diagnose correctly without a good view of the interior of the gut, of which an inch or an inch and a half must be exposed for the purpose; and it is a fact of great surgical importance that the internal opening of a fistula is always within this distance of the orifice.

The external opening of the rectum is occasionally wanting (atresia ani).

The *perineal portion of the rectum* is not much more than an inch in length, it curves back below the prostate, and is uncovered by peritoneum. Just above the anus the rectum is considerably dilated, a condition increased by age and constipation. The folds of mucous membrane, in the empty state of the rectum, so overlap, that considerable difficulty may be experienced in passing the finger or a bougie through them; one fold in particular often obstructs the finger, at about an inch and a half above the aperture. The mucous membrane of the lower end of the bowel is very loose, and readily admits of the burrowing of matter. It must be borne in mind that the curve of the bowel above mentioned necessitates caution in the introduction of an enema tube or other instrument, which should be directed obliquely *from below upwards and forwards*, and afterwards, *upwards and backwards*. (*Vide* "Cavity of Pelvis.")

A dilated condition of the inferior hæmorrhoidal veins at the lower part of the anus constitutes *external piles*.

perficial fascia, tough and strong, and con-
great deal of fat, has cutaneous vessels and
assing through it. The external sphincter
attached posteriorly to the tip of the coccyx,
sing the margin of the anus, is inserted into
al tendon before mentioned. This circular
ibres is about one inch in breadth. Between
l and the tuberosities of the ischium is the
tal fossa, which contains a quantity of loose
llular tissue, and lying across it, and passing to
in of the anus, are the superficial hæmorrhoidal
id nerves, which are liable to give a good deal
e from hæmorrhage, when cut in operations for
c. In shape this fossa is somewhat triangular,
inch in width, and about two inches deep;
its base is formed by the integuments of the
nd its apex, directed upwards, corresponds to
val between the lower border of the obturator
covered by the obturator fascia, and the
rface of the levator ani, covered by the anal
Its boundaries are—externally, the tuberosity
schium and obturator fascia; internally, the
r ani, levator ani, covered by anal fascia, and
s; anteriorly, the triangular ligament; and
ly, the gluteus maximus and great sacro-sciatic

in a fold derived from the obturator fascia,
outer wall of the fossa, the trunks of the
pudic vessels and nerve can be easily felt,
the inner aspect of the tuberosity of the

e external incision for lateral lithotomy the
ks into the ischio-rectal fossa, and will divide
rficial hæmorrhoidal vessels and nerves. Abs-
ave a great partiality for the ischio-rectal
id often burrow to a most remarkable extent.
a in ano is the sinus left on the contraction of
ty of such an abscess. True fistulæ exist
to the sphincter, and always extend as far

up as its upper border. They are called complete or incomplete, according as their openings are situated; thus, in the former case, one opening is in the rectum and the other on the surface of the body, generally near the anus; in the latter, there is an opening into the bowel and none external, or the converse.

The operation for its cure consists in passing a knife through the fistulous track into the bowel, and cutting through all the tissues between the edge of the knife and the interior of the gut. These tissues are—the pseudo-mucous membrane of the fistula, the external sphincter, some few fibres of the levator ani, the branches of the inferior hæmorrhoidal vessels and nerves, the internal sphincter, and the mucous membrane of the inner bowel and its vessels.

The *relations of the bladder and the rectum*, within the reach of the finger, are of great importance; thus, in cases of retention of the urine, when it is necessary to perform the operation of *puncture per rectum*, the distended bladder is felt overlapping the posterior margin of the prostate at a point where, if the puncture be made in the mesial line, no injury to surrounding parts could take place, as the instrument would pass between the vesiculæ seminales, and perforate a space (*trigone vesicæ*) where these structures are neither covered by pelvic fascia nor by peritoneum. The digital examination of the bladder *per rectum* assists the surgeon in the detection or dislodgment of vesical calculi, in guiding the point of a catheter or sound in cases of difficulty, and in the detection of prostatic abscesses, or growths.

Parts concerned in lateral lithotomy in the adult.—The object to be attained is that of opening the bladder at one particular spot, its neck, and for the reason that if opened at any other, urinary infiltration into the areolar tissue of the pelvis will take place. The incisions then must be made in the most direct way, to allow of (1), the position of the staff, which has been introduced into the bladder, being felt; (2), the neck

the bladder being opened, and room obtained for e extraction of the stone.

The perineum having been shaved, the skin and teguments are to be steadied and rendered tense with e fingers of the left hand, and the point of the knife to be entered about an inch and three-quarters in ont of the anus, a little to the left of the middle line, id carried through the skin, in a direction downards and outwards, midway between the anus and ie tuberosity of the ischium. The left forefinger is ext to be pushed into this external wound, with the ouble purpose of feeling for the position of the roove of the staff in the urethra, and for the purose of pushing the rectum downwards out of the ay. When the groove is recognized, the knife, lying at under the introduced finger, is pushed into the rethra just in front of the prostate, and when the oint is felt to be in the groove, it is made to slide long it towards the bladder, dividing in its course the membranous urethra and left lobe of the prostate to the xtent of an inch. The forefinger is now to be pushed long the groove, through the edges of the deep wound, and insinuated into the incision through the prostate; the staff is then withdrawn by the assistant in charge of it, whilst the finger passes into the cavity of the bladder. The forceps are next guided by the under surface of the finger into the bladder. When the stone is felt, the blades must be opened, the finger gradually withdrawn, and an attempt made to catch it in its long axis if possible. When caught, it is to be slowly and firmly drawn out, without hurry, with a slight to-and-fro motion in a direction *downwards*, towards the floor, and not horizontally towards the pubic arch. After the operation a searcher or sound is to be introduced, to find out whether the bladder is free.

Structures divided in the lateral operation of lithotomy.—The superficial incision divides the skin and superficial fascia, inferior hæmorrhoidal vessels and nerves, *which lie superficially* in the anterior part of

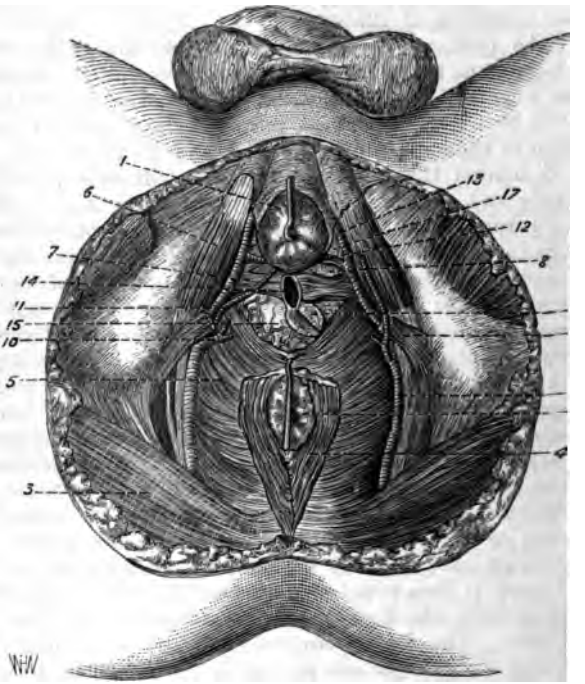


Fig. 55.—Male Perineum. The bulb is slightly raised and the rectum drawn backwards, in order to make clear the membranous urethra and prostate, which are shown incised as in the lateral operation of lithotomy.

1, bulb; 2, rectum; 3, gluteus maximus; 4, external sphincter; 5, levator ani, its anterior fibres raised to show the prostate; 6, erector penis; 7, Wilson's muscle; 8, Cowper's gland; 9, trunk of internal pudic; 10, superficial perineal artery; 11, artery to bulb (abnormal); 12, artery to bulb; 13, continuation of internal pudic artery; 14, urethra divided as in the lateral incision; 15, prostate gland, with its plexus of vessels; 16, incision in the prostate gland as in the lateral operation; 17, anterior layer of triangular ligament; 18, transversus perinei muscle.

io-rectal fossa, transverse perineal muscles and
and superficial perineal vessels and nerves.
ıctures divided *on* the staff are the lower part
triangular ligament, deep transversus urethræ
the *deep* part of the incision divides the
nous urethra, the substance of the prostate,
sels around it.
ures to be avoided.—The *bulb*, or the *rectum*,
f which stands a risk of being wounded, if
incision be too near the middle line; the
pudic artery, if on the other hand the deep
be made too far externally; the *artery* to
b, if it be made too far forward; and the
ry ducts, if it be carried too far backwards
wards.
› entire breadth of the gland and its capsule
ided, the urine would be infiltrated beneath
oneum probably.
epth of the perineum between the neck of the
and the integument varies from rather more
inch to four inches, and between the tubero-
the ischium from two inches or less, to four.
child, the pelvis being narrow, the perineum
r also; and the neck of the bladder compara-
igh up, whilst the peritoneum descends very
een the bladder and the rectum. The bladder
more conical in shape, and is rather an abdo-
ıan a pelvic viscus, and its connexions with
ounding parts are very loose. Hence the
experienced in getting into the bladder in
thotomy in children, and the danger of push-
›rostate before the finger and tearing it from
branous portion of the urethra. There is also
of cutting the urethra considerably anterior
›int indicated as the exact position for entering
ler, therefore always, in children, the external
should be made as large as possible, that the
›osition of the parts be clearly made out.

SURGICAL ANATOMY OF THE PENIS.

The integument of the penis consists, externally, of very loose skin, destitute of fat, which at the corona glandis is reflected over the glans, and has an internal mucous surface continuous with that of the glans; immediately below the meatus urinarius this membrane is gathered into a fold, the *frænum preputii*. Behind the corona, and in the sulcus, are a number of glands which secrete the smegma. Beneath the skin is a layer of loose muscular fibres, analogous to the dartos, arranged circularly and lying in loose cellular tissue. Beneath this is a tough, elastic fascia, enveloping the entire body of the organ, sending in a process beneath the urethra and corpora cavernosa, continuous with the superficial fascia of the perineum, incorporated at its root with the suspensory ligament; between the two laminæ of which lie the dorsal vessels and nerves. The upper portion of the body of the penis is composed of the corpora cavernosa, which, arising from the inner aspect of the horizontal rami of the pubes, unite along the mesial line, this union being marked by a septum, called the *septum pectiniforme*, which, however, is wanting in front. The corpora cavernosa terminate in the front by a rounded margin, which projects into the base of the glans. The inferior portion of the body of the glans is formed by the corpus spongiosum, containing the urethra. It commences in front of the triangular ligament at the bulb, and lying between and below the united crura, terminates at the glans.

The *arteries* of the penis are the dorsal, which lie in the dorsal furrow, supplying the integument, and afterwards pierce its fibrous investment, near the corona; the arteries to the corpora cavernosa, and the arteries to the bulb. The *veins* are very numerous, and are superficial and deep, the former passing into the dorsal vein, which lies between the two dorsal

arteries, and generally terminates in the internal saphena; and the deep, after piercing the triangular ligament, terminate in the prostatic plexus.

The *lymphatics*, with which the organ is richly furnished, accompany the dorsal vessels and pass into the ganglia of the fold of the groin.

The *nerves* lie external to the arteries on the dorsum, and are freely distributed to the body and glans.

The penis is often the seat of an arrest of development, one form of which, where the inferior wall of the urethra is wanting, is termed *hypospadias;* and where the superior wall is wanting, and generally associated with extroversion of the bladder, *epispadias.* Occasionally the prepuce completely encloses the glans, excepting a minute orifice through which the urine passes (*congenital phimosis*).

SURGICAL ANATOMY OF THE MALE URETHRA.

The urethra may be described as extending from the neck of the bladder to the meatus urinarius, and for general division consists of one portion belonging to the penis, and of another belonging to the perineum; with the former is included the spongy portions, and with the latter the membranous and prostatic. It must be examined as regards direction, length, and calibre.

The penile urethra may be considered as the *mobile*, and the perineal, separated from it by the triangular ligament, as the *fixed* portion of the canal, and upon the change in the direction of this fixed portion depends all the difficulty of catheterism.

Spongy portion.—Commencing from the orifice of the urethra, a vertical slit provided with two lip-like margins, the urethral tube is seen at its most constricted portion. On examining the floor of the canal within the meatus, a considerable dilatation is found, termed the *fossa navicularis*, and on the roof of this part of the urethra is the orifice of a large mucous pouch, the

lacuna magna. Behind this dilatation the canal averages about a quarter of an inch in diameter, and is throughout studded, particularly on its floor, with the orifices of glands (glands of *Littré*), opening forwards. About five inches behind the orifice is another pouch-like dilatation contained within the bulb, into the floor of which open the ducts of Cowper's glands.

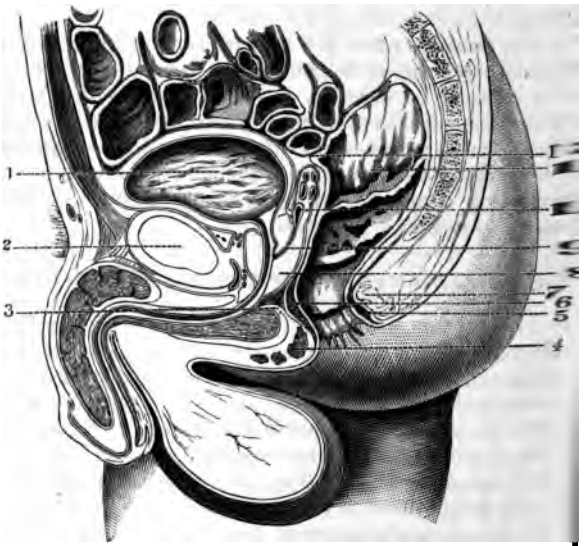


Fig. 56.—Sagittal Section of Male Pelvis in the mesial line (one-third).

1, bladder; 2, symphysis pubis; 3, bulb; 4, external sphincter; 5, internal sphincter; 6, internal sphincter; 7, external sphincter; 8, prostate; 9, ductus ejaculatorius; 10, vesicula seminalis; 11, rectum; 12, pouch of Douglas.

Membranous portion.—This is the narrowest portion of the tube throughout its length, excepting the *sphincter*-like orifice, and is contained between the *layers* of the triangular ligament; it measures about

ee-fourths of an inch along its upper, and half an
h along its lower surface, and consists of mucous
mbrane, elastic, erectile, and muscular tissue.
The prostatic portion is the widest and most dila-
le portion of the urethra; it is about an inch and a
rter long, and lies nearer the upper than the lower
tions of the gland, and its tube is of greater calibre
the middle than at either entrance or exit; on its
r, at the neck of the bladder, is the uvula vesicæ,
ront of which is a ridge of mucous membrane, rather
per behind than before, called the *veru montanum*
caput gallinaginis, having on either side of it a
ch or sinus, into which open the prostatic ducts.
the fore part of the veru montanum is a cul-de-sac,
ning upwards and backwards beneath the middle
e, containing on its floor the openings of the ejacu-
ry ducts; it is called the *sinus pocularis*.
Next, let the urethra be examined as existing during
, as it would present itself to the surgeon.
The urethra may be thus divided into a penile and
erineal portion, and the individual lying on his
k, the usual position for catheterism, its direction
be conveniently described as an ascending portion,
minating at the root of the penis, the bulbous
tion, and a descending, comprising the mem-
nous and prostatic. Thus the points where the
thra changes direction are at the root of the penis
l bulb, and it is in this portion of the canal that
e passages are most frequently made. These curves
appear on catheterism; the first by merely raising
penis, and the second on the depression of the
ndle of the instrument between the thighs. So
ilient are the urethral walls that a perfectly straight
trument can be readily introduced into the bladder.
e urethral canal is distant from the under border of
e symphysis about half an inch or a little more, and
consequently about half an inch or a little more
low the vesical aperture, which corresponds with the
wer border of the symphysis, and is about an inch

and a quarter behind it. When not in use the walls of the urethra touch each other, excepting at the orifice of the meatus urinarius and in the bulb, where they are separated by a narrow interspace.

Catheterism of the male urethra.—If the urethra be healthy, the sound or catheter will pass almost by its own weight, and require scarcely any urging. The instrument is to be introduced into the orifice of the urethra, and pressed gently onwards until it has traversed the canal for four or five inches, when the handle is to be brought to the middle line close to the abdomen, in order that the point may traverse the curve below the symphysis; the handle is then to be brought gently down between the legs of the patient, when it should glide into the bladder. The great point is to keep the extremity of the instrument traversing the *upper* wall of the urethra. Besides, being less moveable, experience shows that in cases of stricture, the upper wall is less liable to be affected than the base and sides. In introducing a small instrument, the position of the lacunæ must be borne in mind, particularly that of the lacuna magna, on the upper wall of the navicular fossa, as it is liable to intercept its point; and if force be employed, it might pass *beneath* the mucous coat. In cases of difficulty, by passing the finger into the rectum the point of the instrument can be directed into the bladder, on account of the close relation of the membranous portion of the urethra and the rectum, and the readiness with which the catheter or sound can be felt through it.

Catheterism in the female is a very easy proceeding generally, and the little papillar orifice which is situated about an inch below the clitoris, in the back part of the vestibule, being detected, a straight instrument is readily slipped in without exposing the patient. When any difficulty is experienced, it is owing to some deviation of the canal or of the neck of the bladder, caused by some tumour pressing upon the parts, which are very mobile.

In *lithotomy in the female* the vesico-vaginal operation is the best, providing the resulting fistula be properly treated. There is, however, a chance of permanent incontinence of urine, on account of the action of the urethral sphincter being destroyed by the incision into the neck of the bladder having been made too freely. It must be borne in mind that when the bladder is fully contracted, the septum between the bladder and vagina is very limited; moreover, in this condition the openings of the ureters are brought very low down, and might be implicated in the incision, which is on no account to be transverse. The length of the female urethra is about an inch and a half, curving slightly below the symphysis, with its concavity upwards, and having an average diameter of about a quarter of an inch, and being highly dilatable, very frequently calculi can be extracted through it. There is a good deal of difficulty experienced generally in using a lithotrite in the female bladder, owing to the fact of its muscular coat being thick and strong and its urethral sphincter so weak, that the urine, or water injected for the purpose of operation, escapes past the instrument, leaving no cavity; moreover, the bladder forms a fossa on both sides of the neck of the uterus.

The arrangement of the *perineal aponeuroses* in the female is as follows:—The superficial layer of superficial fascia is continuous with that of the buttocks, thigh, and abdomen; whilst the deeper layer is firmly attached to Poupart's ligament, the ischio-pubic rami, and to the lower border of the perineal septum. These fasciæ are met with in the labia majora, which are very analogous to the scrotum in the male, and being attached above to the external abdominal ring, hernial pass in them, known as pudendal or labial hernial. This deeper layer of fascia is continuous over the ischio-rectal fossæ. Where the two layers of superficial fasciæ unite with the lower borders of the *perineal septum* to form the perineal body, they are

joined by the ischio-perineal ligament, and it forms a support, or *point d'appui*, for the perineal muscles.

Abscesses in the female perineum are of two kinds, diffuse, in the superficial perineal fascia, which readily spread in all directions; and circumscribed abscess of the vulvo-vaginal gland, which would be seen as an oval projection on the side of the vestibule.

The sacro-coccygeal region offers for surgical consideration a common arrest of development of the neural arches of the sacrum, constituting *spina bifida*, and resulting in the formation of a large cystic swelling; and the nerves (cauda equina) are in this region usually connected with the sac. Hence, if the operation of puncture be deemed advisable, it should always be made on one side of the sac, and at its lowest part.

SURGICAL ANATOMY OF THE CAVITY OF THE PELVIS.

The pelvic cavity contains those viscera, the inferior relations and apertures of which have been described in the preceding section—viz., the bladder, rectum, and vagina, with the uterus and ovaries, the superior surface of the perineum forming its inferior boundary. The soft parts lining its bony walls, the obturatores interni, pyriformes, and levatores ani muscles, are invested with the reflexion of the pelvic fascia, upon which lie the peritoneum and subperitoneal cellular tissue, the arrangements of which are of considerable importance surgically.*

The *pelvic fascia*, which is continuous with the fascia iliaca, is itself a continuation of the transversalis fascia. It is attached to the brim of the true pelvis, and round the margin of the obturator internus muscle. At a curved line between the spine of the ischium and the pubes, this fascia splits to enclose part

* The surgical anatomy of the uterus and ovaries will be better studied in special works on obstetrics.

the origin of the levator ani muscle, the external nina of which (obturator fascia) is applied to the ner surface of the obturator internus muscle, and ssing beneath the obturator vessels and nerve, com-ɜtes the obturator canal; it is attached below to the bic rami, where it forms an investment for the in-ɜnal pudic vessels and nerve. It afterwards sends a in fascia, the anal, over the lower surface of the ɾator ani, which is to be seen covering it in the ischio-ɜtal fossa. The internal lamina (the recto-vesical), is ntinued over the upper surface of the levator ani, er the bladder and sides of prostate, and lower end rectum. The pubo-prostatic ligaments are formed two short rounded bands extending from the capsule the prostate to the posterior aspect of the sym-ɪysis; the capsule of the prostate is formed from the ɜeral attachment to it of this fascia, which also closes the vesico-prostatic plexus of veins. It is this ɾrtion of the pelvic fascia which it is so important to oid dividing posteriorly in the operation of lateral hotomy, for by so doing the urine would find its ɪy into the loose areolar tissue, between the rectum ɪd the bladder. The presence of the prostatic plexus veins is often a serious source of danger. Pos-riorly, the pelvic fascia is continuous over the ɾriformis muscle and sacral plexus, being perforated y the internal iliac artery and vein.

The inlet of the pelvis is somewhat heart-shaped, ell padded along its upper border by the psoas and iacus muscles, while posteriorly, in the middle line, the promontory of the sacrum, or sacro-vertebral ngle, which can be readily felt through the abdominal arietes in thin persons. Between the bladder and ɜctum is the *recto-vesical pouch*, formed by the pelvic ascia, which corresponds posteriorly where it is broad o the interval between the iliac arteries; it is narrow n front between the rectum and the bladder, and ɜxtends as far as the vesiculæ seminales and, in front *and behind, to the tip of the coccyx.* Its relation to

the orifice of the anus is important, and must be referred to the condition of the bladder, which, if distended, will raise the pouch further into the pelvic cavity than its usual level, which is about three inches above the anal aperture. Some coils of the ileum and sigmoid flexure of the colon fill in the space. The peritoneum affording no investment to the lower end of the rectum, the neck, base, and anterior surface of the bladder, or the front and inferior portion of the posterior wall of the vagina, permits of operative proceedings upon these viscera, without danger of wounding it. The space beneath the membrane varies considerably in different parts of the floor of the pelvis: thus, in front and at the sides it is tolerably closely applied to the underlying pelvic fascia, leaving, however, a considerable interspace in front of the bladder, the point selected for puncturing that viscera above the pubis. Behind, and above the anal region, there is a considerable interval, containing a great deal of loose cellular tissue, which allows of the distension of the rectum, and of the internal iliac vessels and their branches, the ureters, sacral, sympathetic and hypogastric plexuses, and the origin of the pyriformis muscle. (*Vide* "Rectum.")

SURGICAL ANATOMY OF THE BLADDER.

The bladder is situated in the mesial plane, beneath the pelvic fascia and peritoneum, and lies obliquely from above downwards. Being attached to the pelvic floor by its body and base only, it is freely moveable, but the urachus and anterior reflexion of the peritoneum limit its mobility posteriorly. When empty, the bladder lies deep in the pelvis as a flattened sac, with its apex reaching up to the symphysis pubis, but when distended, its relations are considerably altered, and are of great surgical importance. When moderately full, it is round and partially fills the true pelvis,

ıt when greatly distended it rises up into the abdomen, ɛrhaps even reaching to the umbilicus, and becomes ırved forwards.

In front of the bladder, between it and the pubes, is quantity of lax cellular tissue, and the peritoneum ɜing reflected from its anterior surface, forwards ıd upwards, allows of its dilatation, and is of great ractical importance in percussing the bladder. It here that puncture over the pubes and the "high" peration of lithotomy are practised, but the freuency of urinary infiltration is greatly against the ıtter proceeding. However much the bladder may be istended posteriorly, this peritoneal cul-de-sac undergoes no modification in its relation to that viscera, on ccount of the presence of the prostato-peritoneal ıponeurosis. Its posterior surface is entirely covered ɔy peritoneum, and is contiguous in the male with the rectum, and in the female with the vagina, and is in relation with some convolutions of the small intestine, which lie in the recto-vesical pouch. Laterally, the peritoneum is applied to the bladder above and behind the crossing of the obliterated umbilical artery, around which it is reflected. The vasa deferentia pass along the side, cross the obliterated umbilical artery, and lie to the inner side of the ureter.

The base of the bladder lies upon the anterior surface of the rectum, from which it is separated merely by a thin layer of cellular tissue in the middle, and laterally by the vesiculæ seminales and vasa deferentia, the former of which are intimately adherent to it, and form two sides of a triangle, the base of which is directed upwards and backwards, and its apex towards the prostate. It is at this spot that puncture of the bladder by the rectum is performed. The neck of the bladder is surrounded by the prostate, and is directed obliquely forwards and downwards.

The general form of the normal *prostate* is that of a chestnut, with its base directed towards the bladder, and *its apex towards the* symphysis, having its longest

diameters antero-posteriorly, and at its base transversely. Its inferior surface rests on the triangular ligament; its upper surface, slightly concave, is intimately connected with the bladder and ejaculatory ducts, which lie together in the middle line immediately behind it. Its anterior surface corresponds to the deep layer of the triangular ligament (pubo-prostatic ligament); the posterior surface is separated from the rectum simply by a little cellular tissue and is applied to the neck of the bladder; and its sides are in relation with the levator ani and with the pelvic fascia. The prostate is invested by a fibrous capsule, derived from the pelvic fascia. The density of this capsule accounts for the intense pain of prostatic abscesses, and forces the pus to find its way, unless relieved, into the urethra. In opening these abscesses in the perineum, there is a possibility of urinary fistula, and in the event of their bursting in the perineum, such fistulæ are certain to form.

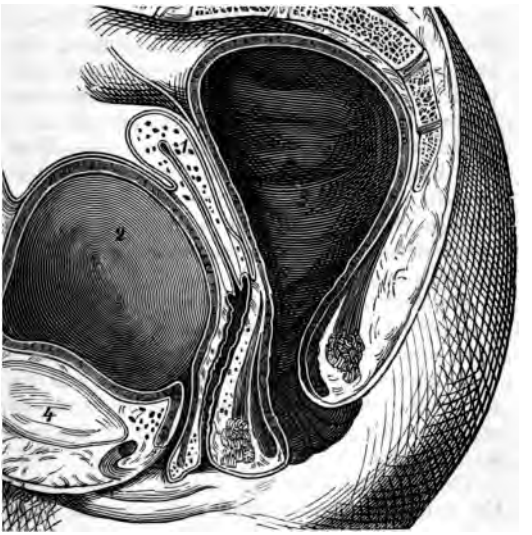
The *position of the prostate gland* with regard to the perineum is readily determined by passing the finger into the rectum, and the organ, if healthy, is generally felt about as far up as the second joint of the forefinger reaches, whilst in some forms of enlargement, the upper border of the gland will be far out of reach of the entire finger.

The cavity of the bladder presents at its base the *trigone vesicæ*, an equilateral triangle formed by the oblique openings of the ureters posteriorly, and by the urethra anteriorly. It is through this triangular space that the trocar enters in puncture per rectum. The trigone is perfectly smooth, and free from rugæ.

Immediately behind the trigone, is the deepest part of the bladder, the *bas fond*—not very much marked in children, but forming a considerable pouch in old persons if there is urethral or prostatic obstruction, in which the urine settles, causing considerable irritation. It is in this pouch that calculi lodge generally.

In the female the bladder is rather larger and rounder than in the male. It has no bas fond. The

s lower, and it and the posterior portion of the
r lies on the vagina; hence it does not descend
as in the male, and its posterior surface is
y covered by the peritoneum. Fistulous open-
casionally occur between the bladder and vagina.



. 57.—Sagittal Section of Female Pelvis (one-half).
1, uterus; 2, bladder; 3, rectum; 4, symphysis.

hildren, the bladder is rather an abdominal than
c viscus, and is conical in shape, owing to the
ı of the but recently obliterated urachus.
els.—The vascular supply of the walls, soft
and viscera of the pelvis is derived from the
es of the internal iliac and from the middle
artery.
r birth *the internal iliac* consists of two trunks,
rior and a posterior—a subdivision which takes

place opposite the great sacro-sciatic notch. The branches given off from the *anterior* are those to the bladder and prostate; superior vesical (the pervious portion of the fœtal hypogastric artery), middle and inferior vesical, the middle hæmorrhoidal to the rectum, the obturator, the internal pudic and ischiatic, and the uterine and vaginal in the female. Those given off from the posterior trunk are the gluteal, ilio-lumbar, and lateral sacral. The gluteal, ischiatic, and internal pudic leave the pelvis by the great sacro-sciatic notch, passing between the sacral plexus of nerves.

Relations of the internal iliac artery.—The internal iliac has, in front, the peritoneum and ureter (rectum on left side); *externally*, the psoas muscle, and obturator nerve; *behind*, the internal iliac vein, lumbo-sacral nerve, and pyriformis muscle; on the right side the vein is more external.

Ligature of internal iliac artery.—This vessel is reached by the same incision as that for the common iliac, and the bifurcation being found, the space is very limited upon which the ligature can be placed: the short thick trunk passes downwards and backwards as far as the upper border of the great sacro-sciatic notch.

The *external* iliac vein lies just in the bifurcation the common into external and internal iliac, and liable to be in the way of the needle in passing ligature. The lumbar and sacral arteries chiefly c on the circulation after its ligature.

RECTUM.

The rectum is a direct continuation of the sig flexure, and commences at the level of the left iliac synchondrosis, and terminates at the anus.

Lateral curvatures.—From the sacro-iliac sy drosis the rectum at first inclines a little to the across the median line, then it reverts again *left.*

tero-posterior curvatures.—After its commence-
the rectum corresponds with the curve of the
m, and follows it to the apex of the coccyx,
ing itself to the posterior wall of the pelvis, so that
ncavity looks directly forwards. In the male the
ior concavity corresponds with the convexity of
bladder, and its lower corresponds with the apex
e prostate, at which point the gut passes abruptly
rds, and after a course of between one and two
s terminates at the anus.
is very important to recollect this in introducing
ments, such as specula or sounds, or indeed the
into the rectum.
libre.—This is not uniform. The straight portion
is enclosed by the sphincters is closely approxi-
l, and offers some resistance to the introduction
ie finger. Immediately above this the rectum
es, forming a kind of pouch or ampulla; the gut
becomes regularly cylindrical. With care and
nce, the entire hand and part of forearm may be
duced into the rectum, a fact of importance in
liagnosis of abdominal tumours, etc. By passing
ntire hand into the rectum in a case of intestinal
uction, the author detected a rare form of hernia,
hich the small intestine had passed between the
s of muscular tissue of the rectum, and protruded
it, completely blocking up its canal, and which
operated on successfully.* (The curves of the
m, considered from below upwards, have been
ly described.)
lation of the rectum to the peritoneum.—This
great surgical importance. The rectum may be
ly divided into an intra- and extra-peritoneal por-
The peritoneum descends lower on its anterior
its posterior surface. It is attached by a small
ntery to the anterior surface of the sacrum, which
s of its free movement in the pelvis, when empty,
as distension occurs its laminæ separate, and

* *Vide* "Trans. Clin. Soc." 1879.

afford room for this distension. At the l
vesiculæ in the male, or the upper fourth o
in the female, it is reflected so as to form
which is distant from the anus about two
inches when the bladder is empty, and about
full.

From the anterior surface the membrane
very obliquely upwards and backwards, an
where it covers the posterior wall of th
from four to five inches from the an
measurements are of great importance in
operations for the removal or partial rem
rectum, or of operations on the bladder c

CHAPTER VI.

ICAL ANATOMY OF THE LOWER EXTREMITY.

:egion of the hip includes, anteriorly, the superior
al region, or the upper third of the front of the
immediately below Poupart's ligament; pos-
ly, the gluteal; and internally, the ischio-pubic
)turator. These several regions cover in the
lation of the hip-joint. The region of the hip-
may be described as having for its limits, the
:rest and sacral groove, Poupart's ligament, and
, a line encircling the limb, just below the
)f the nates.

face markings.—*Anteriorly* and *externally*, are
uscular prominences formed by the tensor vaginæ
is; and *internally*, by the adductors and gracilis.
i surface is crossed obliquely below by the
ius. *Posteriorly*, is the swell of the gluteus
aus; and *internally*, the tuberosity of the
m, and the rami of the pubes and ischium
:d by their muscles.

ICAL ANATOMY OF THE SUPERIOR FEMORAL REGION.

e more superficial structures met with in this
ı have been already described in the chapter on
ıal and crural herniæ, as it was considered con-
ıt to associate them with the region of the
nen (*vide* "*Abdomen*"); but the deeper surgical

relations comprise those of the common femoral and upper portion of the superficial femoral vessels, or *Scarpa's* space.

The structures which concern femoral hernia have already been described, with the arrangement of the *fascia lata*, in its superficial aspect. From the inner surface of this fascia spring two strong prolongations, one an external starting from the junction of the external and posterior aspects of the thigh, and becomes attached to the external edge of the linea aspera, the other internal commences at the junction of the internal and posterior aspects of the thigh, and becomes attached to the posterior surface of the preceding lamina, thus dividing the thigh into two distinct aponeurotic sheaths, which become more developed in the middle femoral region, where they will be described.

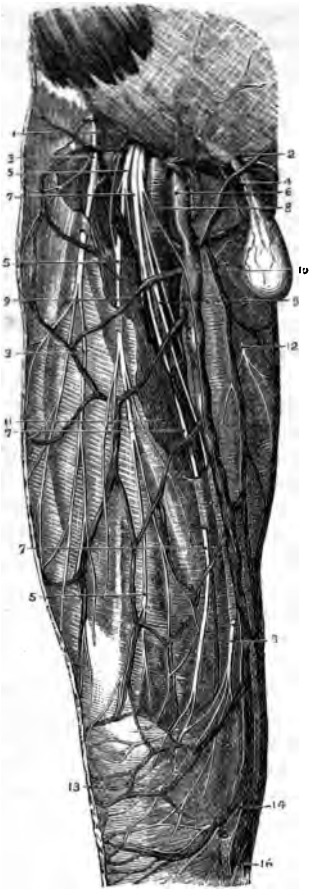
Scarpa's triangle.—This space has for its limits the following:– its *base*, the crural arch; its *external* boundary, the sartorius; its *internal*, the adductor longus. In the centre of the triangle so formed, passing from the middle of its base to the apex (the meeting of the sartorius and adductor longus), lie the femoral vessels. The floor upon which they rest is formed from without inwards by the iliacus, psoas, pectineus, adductor longus, and part of the adductor brevis muscles. The anterior crural nerve lies in the furrow between the iliacus and psoas muscles. The femoral artery lies external to, and a little superficial to its vein. The sheath of the femoral vessels, which has been before described (*vide* "Crural Hernia"), ceases at the division of the common femoral into superficial and deep, and is formed anteriorly by a prolongation of the fascia transversalis, and posteriorly by the fascia iliaca, which furnish septa between the common femoral vessels. The inner margin of the psoas separates the artery from the hip-joint, and *passing* behind the sheath is the branch of the *anterior* crural nerve to the pectineus. Lying on

pectineus, and outer surface of the adductor gus, are the deep external pudic vessels, branches the common femoral, beneath the pubic portion the fascia lata.

)n the outer side of the sartorius is the tensor inæ femoris, passing obliquely downwards and back-ds, to be inserted into the fascia lata; and between nd the sartorius is the upper portion of the rectus oris, with some branches of the external circumflex sels passing outwards into its substance. Passing ards towards the articulation, will be met with, n without inwards, beneath the sartorius and sels, the lower portion of the combined tendons of psoas and iliacus in their sheath; a cellular inter-e between them and the outer border of the tineus, in which lie the internal circumflex vessels, pectineus, and the adductor brevis, also separated a slight interval. Beneath, the upper portion of rectus and the external circumflex vessels, the er part of the vasti, the neck of the femur, and anterior portion of the articulation. Immediately ind the psoas and iliacus tendon and the pectineus, large bursæ separating them from the joint. eath the pectineus and adductor brevis are the rator vessels and nerve, the obturator externus, portion of the adductor magnus muscles.

'emoral artery in Scarpa's space.—The common oral is a continuation of the external iliac, and rs the space below Poupart's ligament, at a point way between the anterior superior spine of the n and the symphysis pubis, and it lies in the al sheath for about an inch and a half or two es, which sheath separates it from the fascia lata inguinal glands.

he common femoral vein lies to its inner side ve, but gets behind it lower down. The anterior al nerve lies about half an inch external to it. It at first *on the psoas* and afterwards on the pec-*us, but separated from* it by the femoral vein and



profunda vessels. It usually gives off four superficial branches—the superficial epigastric, circumflex iliac, and the superficial and deep external pudic. (By the *superficial* femoral is meant that portion of the vessel between the giving off of the profunda and the point where it becomes popliteal.) The *profunda* or *deep* femoral generally arises from the outer and back part of the common trunk, about an inch and a half or two inches below the crural arch; at its commencement this vessel is on the outside of the superficial femoral vessels; but it soon passes behind, and finally reaching the inside, courses downwards and backwards among the adductor muscles. It rests on the iliacus,

Fig. 58.—Superficial Dissection of the Front of the Thigh.

1, Poupart's ligament; 2, superficial branches of femoral artery; 3, external cutaneous nerve; 4, femoral artery; 5, 5, 5, middle cutaneous nerve; 6, femoral vein; 7, 7, 7, outer division of internal cutaneous nerve; 8, 8, 8, inner division of internal cutaneous nerve; 9, branch to sartorius; 10, saphena vein; 11, sartorius plexus; 12, cutaneous branch of obturator nerve; 13, patella; 14, patellar branch of long saphena; 16, long or internal saphenous nerve.

ieus and adductor brevis, and passing between
dductor longus and magnus, terminates in a small
that pierces the magnus. The profunda gives off
xternal circumflex, which, arising from its outer
passes outwards between the branches of distribu-
of the anterior crural nerve, below the sartorius and
s, and divides into three series of branches—ascend-
escending, and transverse. *The internal circumflex*
en off from the inner and back part of the profunda,
s between the pectineus and psoas muscles, and
ite the tendon of the obturator externus, it gives off
ranches: one an ascending, inosculating with the
ator, and a descending, muscular; and the vessel
passes into the gluteal region between the quad-
femoris and adductor magnus, inosculating with
schiatic, external circumflex, and superior perfo-
; vessels. The *perforating* arteries.—The first is
ally given off from the profunda, just above the
n of the adductor brevis, between it and the pec
s, and pierces the adductor magnus; the second
s the adductor brevis and magnus; and the third is
off below the adductor brevis, and pierces the ad-
r magnus. The inosculations of these vessels will
nsidered in the description of the thigh and buttock.
mpression of the femoral artery in the upper
is easily effected, either just as it passes over the
, where the pressure should be made obliquely
vards, on account of the surface of the bone
inclined slightly forwards, or just below Pou-
ligament, at a point where it is very superficial,
separated from the acetabulum and neck of
by the psoas in extension of the thigh.
ature of the femoral artery in Scarpa's space.—
ot in the case of a wound of the vessel, the
on femoral is rarely tied, owing to the number
all superficial and muscular branches, affording
ttle chance of a good coagulum being made. For
eal aneurism, etc., the superficial femoral is tied
t the point before it passes beneath the sartorius.

The knee being slightly bent, an incision of about two or three inches in length is to be made over the course of the artery, dividing the skin, superficial fascia, and fat. Next the fascia lata is to be divided, when the oblique fibres at the edge of the sartorius will be seen, and which are to be drawn aside in order to give room. Some branches of the anterior crural nerve are generally spread out over the course of the vessel, and occasionally the internal saphena nerve crosses it at this point. The sheath is next to be opened, only so much so as to allow of the easy passage of the aneurism needle round the vessel, and the needle should be passed *from within outwards.*

Collateral circulation after ligature of the superficial femoral artery in Scarpa's space.—The external circumflex from the profunda anastomoses with the gluteal and circumflex iliac, the internal circumflex with the obturator ischiatic, and superior perforating, and the vessels in the popliteal space with the comes nervi ischiadici.

The *tumours* in Scarpa's space, which might be mistaken for aneurisms, are enlarged glands, cysts, psoas abscess, enlargement of the bursa below the psoas, and hernia. Femoral herniæ lie to the inner and upper side of the vessels; psoas abscesses point external to them. Inguinal herniæ may be mistaken for crural, owing to the circumstance that adhesions taking place from any cause between the aponeuroses may divert their course; it is far more common for crural herniæ to resemble inguinal (*vide* "Crural Hernia").

SURGICAL ANATOMY OF THE GLUTEAL REGION.

This region is of great surgical importance from its intimate relations with the hip-joint, and the control the muscles have over its several movements; it has *for its limits*, in *front*, the anterior superior spine of *the ilium*, and the margin of the tensor vaginæ femoris;

riorly the crest; *posteriorly* the posterior superior
e of the ilium, the sacrum, and the middle line of
body; *below* the tuberosity of the ischium, and
of the nates.

opography.—Beneath the skin there is a con-
rable amount of fat, particularly over the tuberosity
he ischium, in which lie a number of cutaneous
es, supplying the integument; the fascia lata,
h is thin over the gluteus maximus, and very
k in front over the gluteus medius, to which it
s origin; next, the gluteus maximus, and the
rior and superior portion of the medius.

eneath the gluteus maximus lie, first of all, a
-cellular layer, continuous with the subperitoneal
lar tissue through the great sacro-sciatic notch,
rtion of the gluteus medius, sacro-sciatic ligaments,
formis muscle, with the sciatic vessels and nerves
ging below its inferior border; the obturator
nus, with its satellite muscles, the gemelli; the
nal pudic vessels and nerve with the nerve to the
rator internus, the quadratus femoris, the tube-
y of the ischium with the origin of the hamstring
cles, the great trochanter covered by a large bursa
osa, which separates it from the gluteus maximus,
part of the origin of the vastus internus, the
rficial gluteal vessels, and the anastomoses of the
rnal circumflex with the gluteal vessels, the
eus minimus muscle, the posterior part of the
ulation of the hip-joint; and beneath the quad-
s femoris, the obturator externus and the anas-
osing branch of the internal circumflex.

he gluteal artery, generally the larger terminal
ch of the posterior division of the internal iliac,
es out of the pelvis, at the upper part of the
e sacro-sciatic notch, and lies between the gluteus
mus and pyriformis. It may be the seat of
rism, either idiopathic or traumatic, and the
el in either *case* may be readily reached in actual
ice, without attendance to the somewhat com-

plicated directions given for finding it; in the former case the swelling caused by the position of the sac, and in the latter the direction of the already existing external wound, would guide the surgeon.

The internal pudic artery lies very deep in the gluteal region, and having escaped between the pyriformis and levator ani, emerges from the pelvis at the great sacro-sciatic notch, and winds round the spine of the ischium accompanied by its nerve; again reaching the pelvis at the lesser sacro-sciatic notch, it lies on the inner surface of the ischium, and is there covered by a process of the obturator fascia (*vide* "Perineum").

The great sciatic nerve emerges from the greater notch at its lower portion, and lies exactly between the tuberosity of the ischium and the great trochanter.

The inter-muscular, cellulo-fatty membranes, which are so extensive in the gluteal region, freely intercommunicate with those within the pelvis, and readily explain the passage of pus either from or into its cavity.

Sciatic herniæ occasionally exist, a portion of intestine passing down through the greater sacro-sciatic foramen, and having the vessels posterior to its sac.

The bursa over the great trochanter is sometimes the seat of abscess, which has been mistaken for disease of the hip-joint.

OBTURATOR OF ISCHIO-PUBIC REGION.

This forms the inner boundary of the region of the hip, and comprises the obturator foramen, the structures covering it on either surface, and the parts immediately adjacent. The bony prominences are easily felt; they are the pubic space and horizontal ramus of the pubes anteriorly, and the descending ramus and tuberosity of the ischium, internally and behind. The anterior surface consists of the gracilis, pectineus and adductors, *beneath* which is the obturator internus. The obturator *foramen is not* entirely filled in by the membrane,

external rotators, and it has been considered that fact explains the corresponding rotation of the ;h in fracture of the neck of that bone, but it is :h more probable that the eversion of the limb is simply to its own weight. External rotation, how- r, is of no diagnostic value in fracture of the k, unless accompanied by actual shortening of limb.

'he *trochanter major* is the great lever into which inserted the rotator muscles of the hip-joint, and is arated from the integuments by the anterior edge of tendon of the gluteus maximus, beneath which is a ;e bursa. Its variable position is readily seen in the eral movements of the hip, describing the arc of a le, owing to its continuity with the neck of the femur. ien the neck of the femur is fractured, the trochanter jor rotates in the axis of the bone, and in case of location, or suspected dislocation, measurements of distance from the anterior superior iliac spine must carefully compared with similar measurements taken the opposite side of the body.

'he position of the *trochanter major*, with regard the several bony projections of the region should carefully studied in every position of the limb. situation is marked by a deep depression, when individual is standing upright with the heels :ther, and its differences of relation in flexion, :nsion, adduction, and abduction, should be com- :d. These relations are obviously of the utmost ortance in the diagnosis of dislocation or fracture iected with the hip-joint.

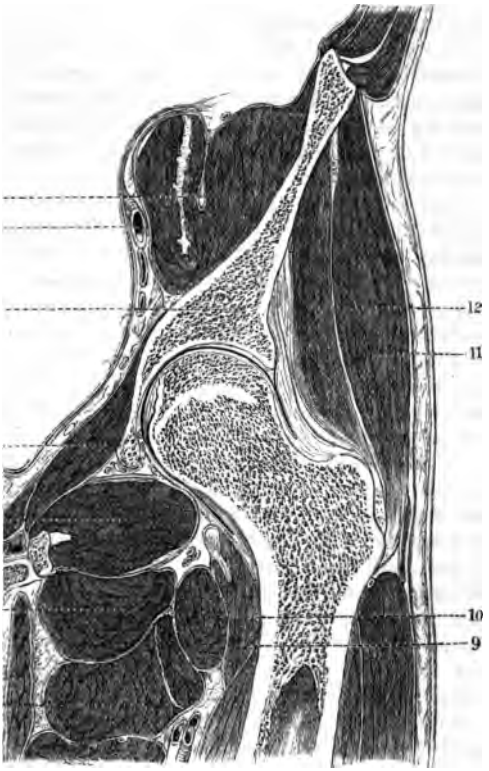
f the exact relations of the great trochanter with the :ral osseous prominences observable on the pelvis normal state be examined, it will be noticed that he femur is flexed at a right angle, and at the e time slightly adducted, the apex of the great hanter corresponds with a line drawn from the :rior superior *iliac spine* to the tuberosity of the *ium, and that this line* divides the cotyloid cavity

and pectineus; *posteriorly* the pyriformis, obturator internus, and gemelli, tendon of obturator externus, and quadratus femoris. All these muscles are in absolute relation with the capsular ligament, and are covered in by the superficial muscles already described. As masses, however, the musculature of the hip-joint is, on account of the relation of the great trochanter to the upper portion of the diaphysis of the femur, somewhat irregularly distributed, so that, externally, it is covered only by the fascia, the tendon of the gluteus maximus, and the skin. Below the great trochanter is a thin muscular layer from the vastus externus; whereas internally is the largest amount of muscles, the adductors, pectineus, gracilis, sartorius, and posteriorly, the joint is completely covered in by the gluteus maximus. It is worth recollecting that the joint is nearer to the anterior iliac spine than to the pubic spine.

Being an enarthrodial joint, the movements of which it is capable are very extensive:—*Flexion*, which is produced by the psoas and iliacus, sartorius and rectus femoris. *Extension*, by the hamstrings and some fibres of the gluteus maximus. In both these movements the neck of the femur rotates on its axis, whilst the inferior extremity of the thigh bone describes an arc of a circle, directly backwards and forwards. *Adduction* is performed by the pectineus, adductors, and gracilis. In this movement the shaft of the femur is adducted to the middle line of the body, and its neck is lowered. *Abduction*, by the gluteus medius and minimus, and the tensor vaginæ femoris. The neck of the femur is raised. *Rotation outwards*, in which the trochanter major is thrown backwards and the foot outwards, by the gluteus maximus and medius, pyriformis, obturators, and quadratus femoris. *Internal rotation*, when the great trochanter is thrown forwards and the foot inwards, by the anterior fibres of the gluteus medius and the gluteus minimus.

It will be seen that the greater part of these muscles

he adult measure its average normal length of a half inches, on the affected or impaired side



Transverse Section of Hip-Joint and its relations. (One-fifth.)

r crural nerve in substance of iliacus internus; 2, . iliac artery; 3, ilium; 4, obturator internus; 5, r magnus; 6, obturator externus; 7 adductor longus, :tor brevis; 9, *ilio-psoas*; 10, pectineus; 11, gluteus *12, gluteus minimus.*

(which, with respect to the surface, may be regarded as occupying the central position between the anterior superior spine of the ilium, the spine of the pubis, and the tuberosity of the ischium) into two equal parts. This line corresponding to the centre of the cavity, will serve as a guide to an appreciation of the extent of displacement in dislocation. Thus supposing the head of the femur be placed behind the cotyloid cavity, this line, instead of corresponding with the apex of the trochanter major, would correspond with a point nearer its base. The extent of the displacement, then, will be measured by the prominence of the great trochanter behind this line. (Nélaton.)

The *triangle* Bryant* describes as the *ilio-femoral*, is formed between the ilium and the great trochanter of the femur. *One* side of it is drawn from the anterior superior spinous process of the ilium to the top of the major trochanter.

The *second* is drawn from the anterior superior spinous process of the ilium directly downwards to the horizontal plane of the recumbent body; and the *third*, which would be the base of the triangle, is drawn at right angles to the second, and falls upon the first line, where it touches the great trochanter.

Mr. Bryant says that first the line corresponds in the normal position of the hip-joint to Nélaton's test line for dislocation of the head of the thigh-bone backwards; and he claims the base of the triangle to be the test line for fracture or shortening of the neck of the thigh bone; and he asserts that whilst in a healthy subject the ilio-femoral triangles of the two sides are exactly similar, in all cases of injury to the hip, in which shortening of the neck of the thigh-bone exists, the amount of shortening can readily and accurately be made out, on comparing the bases of the triangles of the two sides. Again, in impacted fracture, where on the sound side the base of the triangle

* *Proceedings* of Royal Medical and Chirurgical Society, *vol. vii. No. 7.*

will in the adult measure its average normal length of two and a half inches, on the affected or impaired side

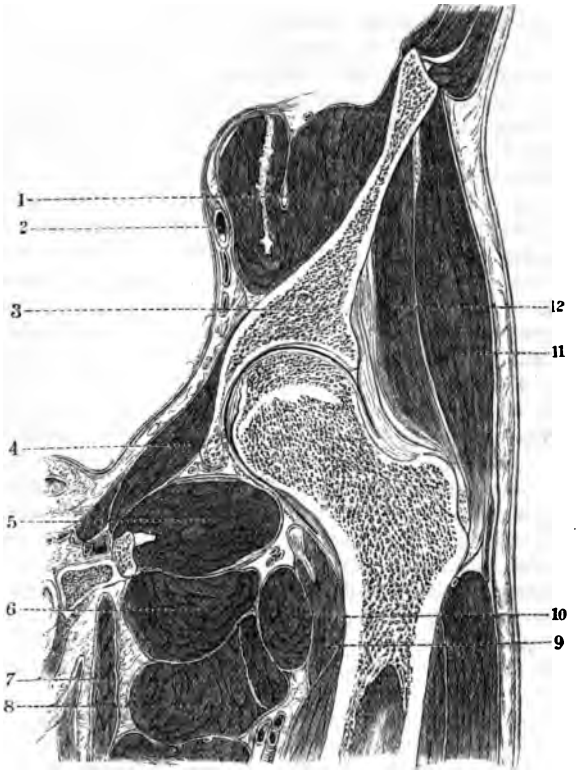


Fig. 59.—Transverse Section of Hip-Joint and its relations. (One-fifth.)

1, anterior crural nerve in substance of iliacus internus; 2, external iliac artery; 3, ilium; 4, obturator internus; 5, adductor magnus; 6, obturator externus; 7 adductor longus; 8, adductor brevis; 9, ilio-psoas; 10, pectineus; 11, gluteus *medius; 12, gluteus* minimus.

it will measure from half an inch to more than one inch less, these measurements being taken with the patient in the horizontal position, the pelvis straight, and the two femora parallel."

The position of the *trochanter minor*, which lies just below the neck, at the superior and inferior aspect of the femur, is of importance to the surgeon in performing amputation at the articulation, as the knife is liable to be locked in it unless care be taken to pass it well behind.

The capsular ligament is the thickest and strongest in the body, and particularly that anterior portion known variously as the ilio-femoral band, or the inverted ⅄-shaped ligament of Bigelow, of which the tail of the Y is attached to the anterior inferior spinous process of the ilium, and the fork to the root of the great trochanter and inter-trochanteric line. It has been shown by Bigelow that this thickened portion of the capsule is the chief agent in producing the characters of the *regular* varieties of luxation. When it is ruptured in dislocation, it is almost always at its base, and so strong is it in some instances, that the margins of the cotyloid cavity have given way.

The neck of the femur varies as regards its obliquity to the shaft with the age of the individual. Before puberty it is very oblique, and almost in a continuous axis with the shaft; in the adult male it is at an obtuse angle with it, and directed upwards, inwards, and forwards, whilst in old persons it becomes horizontal.

The head of the femur presents a smooth ball, of very regular form, somewhat more than hemispherical, directed upward, inward, and a little forward, for articulation with the acetabulum. It has a separate point of ossification, becoming united to the shaft at the eighteenth year.

The *synovial membrane* covers all that portion of the neck within the joint, and is reflected on to the *internal* surface of the capsule, ensheathing the liga-

m teres, and often communicating anteriorly
he bursa beneath the psoas and iliacus. But it
ot envelope the entire length of the neck of the
, it does not extend as far as the insertion of
psule, but is reflected off about two-thirds of an
above it. This is owing to the fact that the
or fibres of the capsular ligament are folded back
surface of the neck, and become continuous with
riosteum—a fact which explains why it is that
tain intra-capsular fractures this membrane is
ved.

cotyloid cavity is deepened by the cotyloid liga-
rendered continuous below by the transverse
nt, beneath which the nutrient vessels pass to
int.

ligamentum teres is attached by its apex into a
just behind and below the centre of the globular
of the bone, and by its base to the margins of
otch at the bottom of the acetabulum, and its
is to check external rotation and adduction when
igh is flexed, thus assisting in the prevention of
ation of the head forwards and outwards. The
n of the cotyloid cavity is very thin, and is liable
foration in caries, in which case the pus invades
elvic cavity. It may be opened by the point of
nife in amputation through the hip-joint, or in
bsequent gouging after resection, unless care be

It is a somewhat remarkable fact that after
eration of disarticulation, or in the case of old
uced dislocation, the cavity contracts.

vessels which supply the articulation are the
tor, ischiatic, internal circumflex, and gluteal;
he *nerves* are from the great sciatic, obturator,
ccessory obturator, and they enter it either by
of the notch, or through the ligamentum teres.

location of the head of the femur.—With regard
displacements of the head of the femur in dis-
on, none of the muscles of the gluteal region
bly exert any influence excepting the obturator

internus, the muscular substance of which is so mixed with tendinous structure as to give it great strength and when in a state of contraction it may be regarded as an accessory ligament to the joint.

The *regular dislocations* of the head of the thigh bone are—(1) upwards, on to the dorsum ilii; (2) backwards, into the great sciatic arch; (3) downward into the obturator foramen, and (4) forwards, on to the pubes. In the *first* form the limb is shortened from one to two and a half inches, and slightly bent the knee resting on the opposite thigh, and the great toe upon the opposite instep, the head of the femur being felt beneath the glutei. In the *second* form the limb is shortened for about half an inch, and the thigh turned inwards and slightly flexed, the ball of the great toe lying on the base of the metacarpal bone of the opposite foot, and the head of the thigh bone protruding below and behind the tendon of the obturator internus. In the *third* form, the limb is lengthened for about one or two inches, the thigh is flexed, and abducted and advanced in front of the opposite one, the toes pointing downwards and forwards, and the trunk flexed on account of the tension on the psoas and iliacus muscle. In the *fourth* form the limb is shortened, rotated outwards, and the head of the bone felt on the pubes, just below Poupart's ligament. The limb, moreover, is abducted, and the foot points directly outwards.

The action of the muscles is well marked in cases of *fracture*, either of the neck of the femur internal to the capsule, or just below the trochanter, as far as the upper fragment is concerned. In the former case, which is *the* fracture of old age, and is a result of the slightest mishap, there is eversion of the limb, produced, according to some authorities, by the action of the external rotators, but far more likely by the weight of the foot alone, and shortening, which is produced by the action of the glutei, rectus, and hamstrings. In the case of fracture below the trochanters,

a result of direct violence, the upper fragment is pulled forwards by the psoas and iliacus, everted and drawn outwards by the external rotators. There is shortening of the limb beyond the point of fracture, owing to the action of the rectus in front and the hamstrings

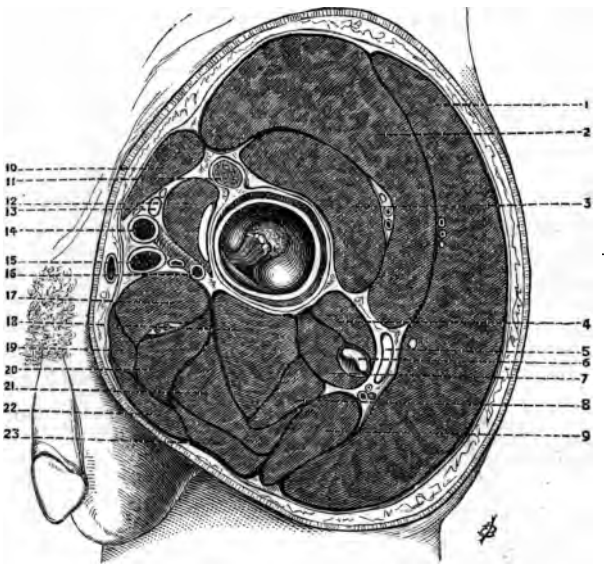


Fig. 60.—Section through the Hip and Gluteal Region (one-third).

1, gluteus maximus; 2, gluteus medius; 3, gluteus minimus; 4, pyriformis; 5, great sciatic nerve and ischiatic vessels; 6, obturator internus; 7 gemelli; 8, biceps; 9, quadratus femoris; 10, sartorius; 11, reflected tendon rectus; 12, psoas and iliacus and bursa; 13, anterior crural nerve; 14, common femoral artery; 15, common femoral vein; 16, profunda vessels; 17, gracilis; 18, semi-membranosis; 19, adductor brevis; 20, semi-tendinosus; 21, obturator externus; 22, adductor longus; 23, adductor magnus.

behind, and the upper end is thrown outwards and the *lower inwards*, and everted by the adductors.

The most important operations in this region are *amputation through the hip-joint*, and *excision of the head of the femur*. In the operation of amputation, supposing the most rapid method—namely, that by anterior and posterior flaps—be performed, the anterior flap can be cut, and the articulation opened by the first thrust of the knife, if a point midway between

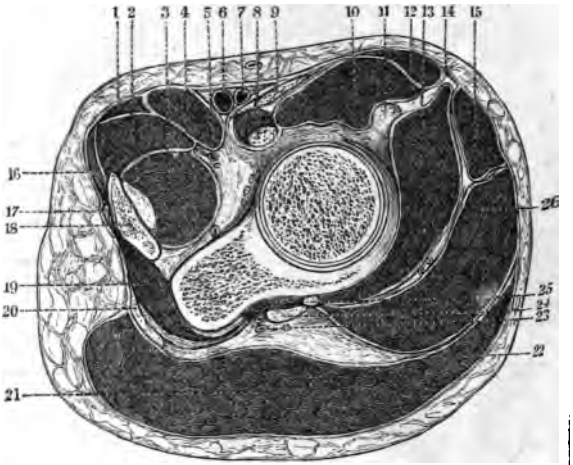


Fig. 61.—Horizontal Section through Hip-Joint (one-fourth).

1, adductor longus; 2, adductor brevis; 3, obturator externus; 4, pectineus; 5, obturator vessels; 6, femoral vein; 7, femoral artery; 8, ilio-psoas tendon; 9, anterior crural nerve; 10, iliacus muscles; 11, reflected tendon of rectus; 12, sartorius; 13, gluteus minimus; 14, external cutaneous nerve; 15, tensor fasciæ; 16, gracilis; 17, corpus cavernosum penis; 18, ascending ramus; 19, obturator internus; 20, great sacro-sciatic ligament; 21, gluteus maximus; 22, gluteus maximus; 23, ischiatic artery and veins; 24, great sciatic nerve; 25, tendon of pyriformis; 26, gluteus medius.

the anterior superior spinous process of the ilium and the trochanter major be taken for entering the instrument, and its point be insinuated onwards towards the

psule, transfixing it, and directed downwards, for-
rds, and inwards, to a point just in front of the
berosity of the ischium; the knife is then to cut
e anterior flap from the front of the thigh, and an
sistant is to help the operator by rotating the limb
rcibly *outwards*, so as to bring the globular head of
e femur and its attached ligamentum teres towards
e surface; the ligament and capsule being divided,
e assistant rotates the limb *inwards*, at the same
ne drawing it towards himself, so that the operator's
ife, after cutting through the posterior portion of the
psule, may clear the trochanter major, and fashion
e hinder flap.

***Structures divided in amputation, through the hip-
nt by the antero-posterior flaps.***—In the *anterior*,
egument, fasciæ, and superficial vessels, sartorius,
terior crural nerve, femoral vessels, rectus, tensor
sciæ, iliacus and psoas, portion of gracilis, adductor
ngus, adductor brevis, pectineus, and profunda vessels,
l part of obturator externus and glutei, with superior
steal and external circumflex vessels and nerves,
psular ligament, and ligamentum teres. In the
sterior, part of the gracilis, adductor longus and
evis, and the adductor magnus and pectineus, internal
cumflex artery, obturator nerve, quadratus femoris,
rt of obturator externus, obturator internus and
nelli, the hamstring muscles, sciatic vessels and
rves, part of gluteus minimus and medius, and the
steus maximus, with its vessels, and the integu-
nts of the buttock.

Excision of the hip-joint.—The joint may be exposed
her by a straight, curved, or T-incision, according to
cumstances; the straight portion should commence
st below the anterior superior spinous process of the
um, and be carried vertically over the trochanter
jor, and the following structures divided:—the
steus medius and minimus, obturator internus and
nelli, obturator externus, pyriformis muscles, and
e *capsular ligament*. The head of the bone is pro-

truded through the wound by bringing the knee of the affected side forcibly across the opposite thigh, with the toes everted. The bone is to be divided below the level of the trochanter major. A more scientific proceeding is to separate the periosteum entire from the trochanter, leaving the attachment of the muscles; by this means they retain in a great measure their proper action, and, moreover, new bone is thrown out.

SURGICAL ANATOMY OF THE MIDDLE FEMORAL REGION.

The limits of this region may be indicated *superiorly* by a line drawn round the thigh at the fold of the nates, and *inferiorly* by one drawn round the lower portion of the thigh at about an inch above the patella; it has the form of a truncated cone, with the base directed upwards.

Surface markings.—Anteriorly, the prominences of the oblique crossing of the sartorius, extending from the anterior iliac spine to the inner side of the knee, and of the tensor fasciæ femoris, enclosing a triangular interval, in which is the commencement of the quadriceps extensor, which forms two curved muscular masses, fuller inferiorly, and enclosing a small triangular interval immediately above the patella, corresponding to its tendon of insertion. *Posteriorly*, the surface is convex, and inferiorly is seen the divergence of the muscular masses which form the popliteal space. *Externally*, the surface is convex, and separated from the posterior by a deep furrow, marking the position of the external intermuscular aponeurosis. *Internally* and superiorly is the superior femoral region and Scarpa's space; the middle of this surface is flat, and indicates the position of the crossing of the sartorius; inferiorly is a large oval eminence, due to the vastus internus.

The course of the femoral artery, which is seen *pulsating* in Scarpa's space, is indicated by a line

drawn from the centre of Poupart's ligament to a point just behind the internal condyle of the femur.

Topography.—The *skin* of this region is very thick posteriorly, thinner in front and internally, and freely supplied with sebaceous glands in the upper and inner portion near the groin.

The subcutaneous cellular tissue generally contains a good deal of fat, and the superficial veins, nerves, and lymphatics lie in it. The most important superficial vessel is the *internal saphena vein;* its course in the thigh commences just behind the posterior part of the internal condyle, and passing obliquely upwards perforates the fascia lata at the saphenous opening, being there invested by the cribriform fascia, and terminates in the common femoral vein. It is very subject to a varicose condition, and may become enormously dilated.

The course of the *lymphatics* is pretty much that of the vein, and they terminate in those lymphatic ganglia, situate in Scarpa's space, which lie in the axis of the thigh.

The *superficial nerves* are derived from the anterior crural, ilio-inguinal, and crural branch of genito-crural nerves; and posteriorly the integument is supplied by the lesser sciatic.

Beneath the subcutaneous cellular tissue is the *fascia lata,* forming an envelope for the muscles, the arrangement of which in the upper portion of the thigh has been described with those regions. A very strong dense process, into which the tensor fasciæ is inserted, is attached to the head of the fibula and to the outer surface of the knee-joint. This fascia invests the muscles so closely and firmly that its rupture allows of the bulging of the fibres of the subjacent muscles to an extent which would hardly be credited unless seen. Processes of this enveloping fascia form special sheaths for the muscles.

The fascia lata is attached deeply, on the outer side, to the *line leading from* the trochanter major to the

linea aspera, and extends downwards to the tip of the external condyle, and on the inner side to the line leading from the lesser trochanter to the linea aspera, and downwards to the tip of the internal condyle. Hence it will be seen that the intermuscular septa thus formed divide the thigh into two distinct compartments—an anterior and a posterior.

An intercommunication, however, does take place, owing to the passage of the femoral vessels through the adductor opening, of the perforating branches superiorly, and of the upper articulating branches of the popliteal vessels inferiorly.

The *anterior* of these compartments, beneath the fascia lata, contains externally and above the tensor fasciæ, which is inserted obliquely into its substance; the sartorius, in its own sheath, which passes obliquely from the anterior superior iliac spine, and wraps round the thigh, being throughout its extent from the apex of Scarpa's space, a satellite to the femoral artery and vein; between these muscles lie the rectus femoris, becoming associated in the inferior third with the underlying muscles, the vasti and crureus, which envelope the femur from the great trochanter to the patella. Beneath the crureus is the subcrureus, inserted into the synovial membrane of the knee-joint, which extends upwards beneath the extensors and the periosteum of the femur for about three to four inches. Its office is to draw up the membrane, so that in extreme and sudden extension of the articulation it may not be pinched between the femur and the patella.

The femoral artery in the middle of the thigh—Hunter's canal.—Commencing at the apex of Scarpa's space, the artery describes an oblique course, lying covered over by the sartorius in its sheath, immediately beneath which is a strong fibrous aponeurosis, derived from the vastus internus externally, and the tendons of insertion of the adductor longus and magnus *internally*. This aponeurosis is very thin in the *upper* part of the middle femoral region, but becomes

very dense lower down, terminating in a sharp margin, beneath which the internal saphena nerve leaves the vessel. Eternal to the femoral vessels is the vastus internus muscle; and internal to them are the tendons of adductor longus and magnus, and behind them are the conjoined tendons of the vastus internus and adductors; and in the middle third, the fibres of the

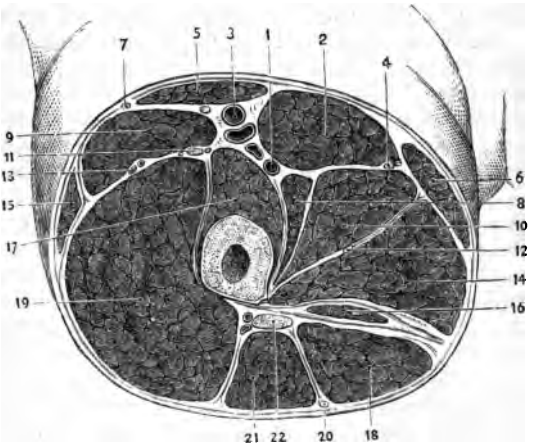


Fig. 62.—Section of the Right Thigh at the apex of Scarpa's Triangle.

1, profunda vessels; 2, adductor longus; 3, femoral vessels; 4, superficial obturator nerve; 5, sartorius; 6, gracilis; 7. external cutaneous nerve; 8, pectineus; 9, rectus femoris; 10. adductor brevis; 11, anterior crural nerve; 12, deep obturator nerve; 13, external circumflex vessels; 14, adductor magnus; 15, tensor fasciæ femoris; 16, semi-membranosus; 17, vastus internus and crureus; 18, semi-tendinosus; 19, vastus externus; 20, small sciatic nerve; 21, biceps femoris; 22, great sciatic nerve.

vastus internus alone, separate the vessels from the femur. In this canal, which is triangular in section, with its apex at the femur, lie the femoral artery and vein posterior to and very intimately united with it;

the long saphena nerve enters it with the vessels, above and externally, and after crossing the artery, leaves the canal at the point above indicated, and is distributed to the skin of the knee and inner side of the leg. The *anastomotica magna* artery is generally given off from the trunk, just before the vessel becomes popliteal, that is, before it passes through the adductor opening.

The superficial femoral is easily *compressed* against the femur, at about the middle of the inner third of the thigh.

Ligature of the femoral artery in Hunter's canal.—This operation is rarely performed now-a-days, unless it be for a wound in this portion of its course, the ligature of the femoral for popliteal aneurism being applied in Scarpa's space.

An incision is to be made in the course of the vessel about three inches in length, through the integument and fascia lata, until the oblique fibres of the sartorius are recognized. Its edge reached, the muscle is to be pulled upwards, when the aponeurotic fibres bridging over the vessels will be seen. These are to be pinched up and divided on a director, when the artery (and perhaps the internal saphena nerve) will be seen with its vein, which is either behind it, or a little to its outer side, and closely united to it by a dense fibrous investment. Occasionally the anastomotica magna is very large and superficial, and may be mistaken for the main trunk.

The posterior compartment of the thigh, as formed by the fascia lata, contains—the hamstring muscles, the great sciatic nerve, a great deal of fat and cellular tissue, and the terminations of the perforating branches of the deep femoral vessels; it presents but few points of surgical interest.

If amputation through the middle third were performed by means of antero-posterior flaps (the operation to be preferred), the *anterior* would contain the *integuments* of the thigh, with the cutaneous nerves

and internal saphena vein, the rectus, sartorius, adductor longus, brevis, and gracilis muscles, obturator nerve, femoral vessels, and branches of anterior crural nerve, a portion of the vastus externus, internus, and adductor magnus muscles. The *posterior*, portion of vastus externus and internus, adductor longus, brevis, and magnus muscles, deep femoral and perforating vessels, the hamstring muscles, great sciatic nerve, lesser sciatic nerve, and integuments of back of thigh. If the amputation be performed near the knee, the muscles are liable to great contraction, since they take their fixed points at the pelvis superiorly. Hence the flaps, which should be lateral, external and internal, must be cut as long as possible. The strong fibrous sheaths of the muscles favour the bagging of pus in amputations through the thigh.

In cases of *wounds* of the thigh, in which either the superficial or deep femoral is implicated, an approximative diagnosis of the site of the escape of blood may be made by examining the posterior tibial artery at the inner ankle. If it pulsates, in all probability the superficial femoral is intact, and the profunda wounded; on the other hand, if the superficial femoral be the seat of injury, the blood, instead of continuing its course along it, and causing pulsation in the posterior tibial, is escaping into the surrounding tissues, and forming a false aneurism. In enlarging the wound to find the bleeding point, it must be remembered that the profunda is external to the superficial femoral, and that the veins of either will be most likely involved.

In *fractures* of the shaft of the femur, the lower fragment is always drawn to the inner side of the upper one, and usually rotated outwards, although in some instances inwards: in the former case, owing to the contraction of the psoas and iliacus, and external rotators; in the latter, to the internal rotators.

SURGICAL ANATOMY OF THE REGION OF THE KNEE.

This region is limited below by a line drawn round the leg just below the internal tuberosity of the tibia; it will be thus seen that the popliteal space, which partly belongs to the lower third of the thigh, the knee-joint, and the upper portion of the leg, is conveniently associated with the surgical anatomy of the knee.

Surface markings.—If the leg be *extended* on the thigh, from above downwards, in front is the tendon of the quadriceps extensor, in which lies just under the skin the patella, from the lower border of which descends the ligamentum patellæ passing to its insertion in the tubercle of the tibia; on either side of the quadriceps extensor tendon is a deep furrow, between it and the vasti muscles. In cases of synovitis, this furrow is obliterated owing to the collection of fluid causing the synovial membrane to bulge beneath the tendon. If the leg be *flexed*, the condyles of the femur, and the interspace between them, are very evident, and the patella fills up the interval between the femur and the tibia, the tuberosities of which are readily seen. In front of the patella and ligamentum patellæ the integument is slightly raised at a spot corresponding with the bursa patellæ.

Posteriorly, during complete extension the surface of the popliteal space is convex, and the position of the muscles which bound it, although evident, is not so pronounced as when flexion commences; the most salient tendon is that of the semi-tendinosus. The position of the external and internal popliteal nerves lying in the middle of the space is easily seen during *extension*, as, being put on the stretch, they lie immediately beneath the integument, and resemble tendons. *Externally*, the knee presents a depression,

rmed by the obliquity of the axes of the femur and bia, the deepest part of which corresponds with the osition of the outer interarticular fibro-cartilage. bove this is the external condyle of the femur, elow the external tuberosity of the tibia, whilst osterior to it is the head of the fibula and tendon of iceps; just behind the tendon of the biceps, and elow the head of the fibula, can be felt the external opliteal nerve. *Internally* can be felt the internal ondyle and internal tuberosity of the tibia, separated y the position of the interarticular fibro-cartilage. he internal saphena vein is seen beneath the integument just behind the inner condyle.

The skin of the region is very thick and dense, and he subcutaneous cellular tissue contains the internal aphena vein and nerve; on the inner side and in front f the patellæ, the bursa patellæ, effusion into which onstitutes the affection known as "*housemaid's knee.*" n the early stage, inflammation of this bursa is to be istinguished from *synovitis* by the fact of the patella eing hidden by the distended sac, whilst the cavities n either side of it remain; the fibrous tissue, however, long the edge of the patella being thin, pus may find s way into the synovial cavity. The aponeurosis is a ontinuation of the fascia lata, and is attached firmly to ie tubercle of the tibia and its tuberosities, to the ead of the fibula, afterwards blending with the fascia ta of the leg. Beneath this aponeurosis lie the muscles, hich have the following relations:—

Internally are the sartorius, gracilis, and semindinosus, the tendons of which muscles strengthen e aponeurosis by their fibrous expansions, and are parated from the tibia by a large bursa, and the semiembranosus; *externally,* the tendon of the biceps; *teriorly,* are the tendon of the quadriceps extensor and e ligamentum patellæ, between which and the tibia is bursa (*bursa of Cloquet*). The articular branches of e popliteal, anterior tibial recurrent, and anastomotica *agna ramify on the* capsule.

The popliteal space forms the posterior aspect of the knee.

Topography.—The skin is thin, and has beneath it a considerable amount of fat. It contains a number of lymphatic glands which are liable to suppuration, or to enlargement after injuries to the foot or leg; they are divided into two series—a superficial, which accompany the saphena veins, and a deeper which lie with the popliteal vessels; suppuration in these glands has been mistaken for aneurism.

The external saphena vein lies in this tissue before it perforates the popliteal aponeurosis to join the popliteal vein; here also are some branches of the small sciatic nerve. The popliteal aponeurosis is continuous with the fascia lata above and fascia of leg below, is attached to the bony prominences and ligaments, and forms sheaths for the muscles and vessels of the space; strong transverse bands stretch across the space, and by connecting the tendons of the ham-strings, the fascia is rendered very tense. This fascia, from its strength and power of resistance, complicates the diagnosis of tumours in the space.

The boundaries of the popliteal space are, *externally*, the biceps above, the external head of gastrocnemius and origin of plantaris below. *Internally*, the tendons of the semi-tendinosus, semi-membranosus, gracilis, and sartorius above, and the inner head of the gastrocnemius below.

These muscles are very subject to contraction after strumous disease of the knee-joint, and to cause subsequent dislocation of the leg upon the thigh, in cases where the disease has not been combated by treatment. Connected with the tendons of these muscles are bursal sacs, which are of surgical importance, as if enlarged or inflamed they may offer some difficulties in diagnosis. Thus, one exists between the inner head of the gastrocnemius and the condyle of the femur, and often communicates with the joint, another exists between the tendon of the semi-membranosus and the

tibia; the bursa beneath the outer head of the gastrocnemius is generally a prolongation of the synovial membrane of the joint, and between the popliteal tendon and the posterior and external lateral ligaments there often are found separate bursæ.

The muscles above mentioned enclose a lozenge-shaped space, containing a large quantity of fat and cellular tissue, in which lie the popliteal vessels, nerves, and some lymphatics; as this fat and cellular tissue is continuous with that surrounding the muscles of the back of the thigh and calf, any collections of pus in the space are liable to extend up the limb or downwards amongst the muscles of the back of the leg. Most superficial in the space, on the outer side, is the external popliteal nerve, which lies on the inner margin of the biceps tendon, and must be carefully avoided in tenotomy; the external saphena vein lies to its inner side, after having perforated the popliteal aponeurosis. More internal still is the internal popliteal nerve, which is the continuation directly downwards of the sciatic nerve, in the inferior portion of the space; this nerve gives off a leash of branches which supply the muscles of the calf, and a filament, the communicans poplitei, which joins a corresponding one from the external popliteal, the communicans peronei, forming a loop which generally lies in the sulcus, between the two heads of the gastrocnemius (*external saphena*). The sheath of the popliteal vessels is very dense, and encloses the *popliteal artery and vein*, which latter lies internal to the internal popliteal nerve, and superficial to the artery.

The popliteal artery.—The course of this vessel in the space is indicated by a line which, commencing at the centre of Poupart's ligament, and wrapping round the thigh, would fall immediately between the two condyles of the femur behind; commencing at the opening in the adductor magnus, it extends to the lower border of the popliteus muscle; it lies close to the surface of the bone, and gives off its articular branches nearly at

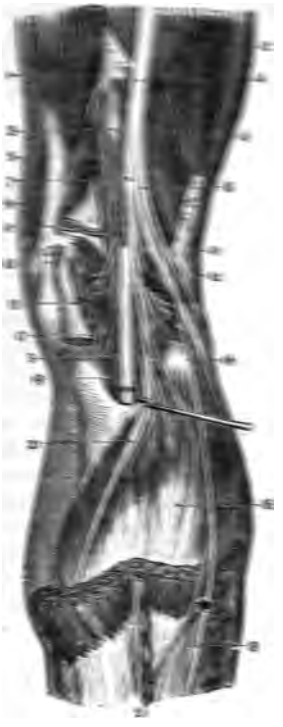


Fig. 62.—Deep View of the Popliteal Space.

1. *adductor magnus*; 2. *vastus externus*; 3. popliteal vein; 4. *great sciatic nerve*; 5. popliteal *artery*; 6. short head of biceps; 7. *internal popliteal nerve*; 8. *external popliteal nerve*; 9. *vastus internus*; 10. long head of biceps (cut); 11. superior internal articular artery; 12. outer head of gastrocnemius; 13. *tendon of semi-membranosus*; 14. *communicans peronei nerve*; 15, *inner head of gastrocnemius*; 16. soleus; 17. inferior internal *articular artery*; 18, gastrocnemius; 19, popliteus; 20. external *saphenous vein and nerve*; 21, tendon of plantaris.

right angles to its course. Between the artery and the vein is the articular branch of the obturator nerve, which supplies the knee-joint. The artery and vein are in such intimate relation that it would be almost impossible for a puncture-wound of the limb which entered the artery not to involve the vein also.

Relations of the popliteal artery.—*In front*, just beneath the tendinous arch in the adductor magnus tendon, is the inner side of the femur; having passed round that bone, it lies that portion of it between the bifurcation of the linea aspera in front of it, in the middle of its course the posterior ligament of the articulation, and below, the popliteal fascia. *Behind*, is the popliteal vein, internal popliteal nerve, aponeurosis; *externally*, biceps; *internally*, semi-membranosus.

The branches of the vessel are the muscular,

the superior and inferior external and internal articular, and the azygos, which pierces the posterior ligament. These vessels maintain a very free anastomosis round the joint amongst themselves, the anastomotica magna, anterior tibial recurrent, and muscular branches.

Ligature of the popliteal, for spontaneous aneurism, as a definite operation is never practised in modern surgery, for reasons which will be found discussed in works on aneurism.

The popliteal vein is intimately united with the popliteal artery. It is a matter of considerable importance that, in the peculiarity of its relation with its artery and its appearance and existence, it resembles no other vein in the body. It is very thick, resembling an artery, both in appearance and structure, hence (in the dead body at least) the difficulty so often experienced in applying a ligature.

The *diagnosis of tumours* in the popliteal space may, in most instances, be reduced to anatomical principles, thus: such tumours must be either aneurism (circumscribed or diffused), abscess, enlarged glands, cysts, or growths, &c. In the event of an aneurism, compression of the femoral would empty its sac, and the sound communicated to the ear by a stethoscope would be of a prolonged, blowing nature. Cysts, such as those alluded to as connected with the tendons, even if they have a communicated pulsation from being so closely packed together with the vessel, could be dragged away from it, and then these seeming pulsations would cease, and moreover they are always lateral. In the diagnosis between an abscess and an aneurism the sac of which had suppurated, or between an abscess and ruptured popliteal artery, forming a diffuse aneurism, difficulty might be expected; but here the condition of the pulse below will generally determine the case.

SURGICAL ANATOMY OF THE KNEE-JOINT.

Three bones enter into the articulation of the knee-joint, *viz., the femur*, the patella, and the tibia. The

structure of the bones entering into the formation of the joint is the same in each instance—cancellated tissue, enclosed in a layer of compact tissue. The articular extremities of the bones are well supplied with blood-vessels; these enter the patella on its anterior, and the femur on its posterior surface.

The articular surface of the patella is divided vertically by a crest into two facets, the rounder of which corresponds with the outer, and the longer and flatter with the inner articular portion of the trochlea.

The lower articular end of the femur is convex in front and concave posteriorly, and the internal condyle is lower than, and a little posterior to, the external, presenting on its inner side the inner tuberosity for the attachment of the internal lateral ligament, and a well-marked tubercle, very plainly felt beneath the integument, for the attachment of the tendon of the adductor magnus. The tuberosity of the outer condyle is less prominent than that of the inner, and gives attachment to the external lateral ligament. The articular surface extends higher on the outer side than on the inner, and is moreover in advance of it and broader. During complete flexion only, the patella occupies the centre of the trochlea, but in extension it overlaps the outer portion of the articular surface, and rises, if the extension be extreme, half its diameter above it.

The femur and the patella are united by the fibrous capsule and by the tendon of the quadriceps extensor. The great power exerted by the action of the rectus on the patella above, and its strong attachment to the tibia by the ligamentum patellæ below, explain how this bone may be fractured transversely by muscular action. The action of the vasti is rather to drag on the patella transversely.

Dislocations of the patella.—This bone is most frequently dislocated *outwards*. The bone lying above *and external* to the external articular surface of the *trochlea*, the outward traction of the extensor muscles

ours this form of displacement. Dislocation in-
rds is very rare. Dislocation with the bone lying
tically either on the outer or the inner condyle is
o very rare.*

The articulation between the femur and the tibia.—
e inner articular surface of the condyle of the femur
less prominent anteriorly than the external, but is
lower and extends a little further backwards, and
more oblique laterally. These surfaces are separated
steriorly by the intercondyloid notch. The head of
e tibia presents two concave articular surfaces, the
ternal of which is the rounder, separated by the
ine, in front and behind which are rough depressions
which are attached the crucial ligaments.

The femur and tibia are united by the capsular
gament, posteriorly by the posterior ligament, which
a prolongation upwards of the tendon of the semi-
embranosus, an internal and external lateral ligament,
vo crucial, the anterior or external and the internal or
osterior, and the two interarticular semi-lunar fibro-
rtilages.

The synovial membrane of the knee-joint ascends
wards beneath the extensor muscles, as a pouch, for
out three inches, and is reflected from the articular
rfaces of the femur, to the crucial ligaments and
bicular surface of the tibia, enveloping the semi-lunar
rtilages, and at the back of the external forms a
uch between its surface and that portion of the
ndon of the popliteus which is within the capsule;
then lines the capsular ligament.

The lower epiphysis of the femur presents an
ified nodule at the ninth month of fœtal life, a
t of considerable value medico-legally in deter-
ning the age of the child. The entire epiphysis,
wever, does not unite with the shaft until the
entieth year; the upper epiphysis of the tibia at the
enty-fifth year.

Vide case in practice of author, "British Medical Journal,
ember, 1872.

Movements of the knee joint.—*Flexion* is perfor
the biceps, semi-tendinosus, semi-membranosus,
teus, and accessorily by the gastrocnemius. *Ex*
by the quadriceps extensor, and tensor vaginæ fe
When the leg is semiflexed, the joint can be int
rotated by the sartorius, semi-tendinosus, and gr
externally by the biceps.

Relations of the knee-joint, externally.—The
of the biceps and the strong process of fascia la

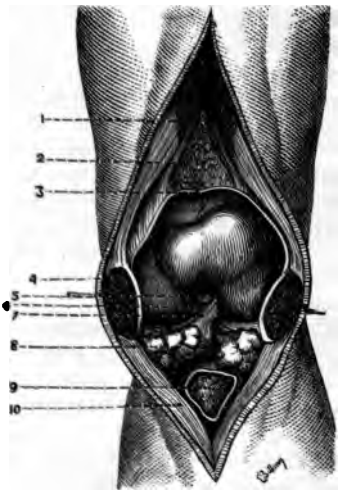


Fig. 64.—Knee-joint Opened Vertically. (One-half

1, tendon of quadriceps extensor; 2, sub-crureus; 3, cut synovial membrane; 4, patella divided vertically; 5, liga mucosum; 6, posterior crucial ligament; 7, anterior ligament; 8 adipose tissue; 9, bursa beneath liga patellæ; 10, ligamentum patellæ.

which is inserted the tensor fasciæ; *internally* little *posteriorly*, the sartorius, semi-tendinosu *cilis*, and semi-membranosus, all these tendo enclosed in bursal sheaths; posteriorly, the ter

the popliteus and the tendon of the muscles forming the popliteal space, with the contents of the space itself.

Fracture of the patella when due to muscular action is always transverse, and the separation of the fragments is caused through the upward traction of the rectus acting on the upper one, whilst the lower is retained in position by the ligamentum patellæ. With a view to treatment, the tension should be relaxed, by extending the leg on the femur, and by slightly flexing the thigh on the pelvis so as to relax the rectus muscle.

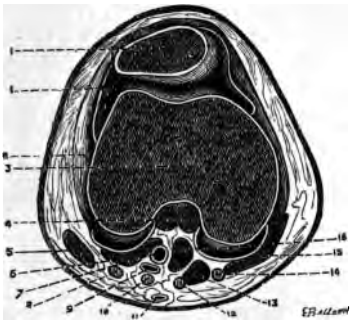


Fig. 65.—Horizonal Section of Knee-joint. (One-half.)

1, patella; 1', synovial membrane; 2, capsule; 3, femur; 4, crucial ligaments; 5, biceps; 6, outer head of gastrocnemius; 7, popliteal artery; 8, external popliteal nerve; 9, popliteal vein; 10, internal popliteal nerve; 11, external saphena vein; 12, semi-tendinosus; 13, semi-membranosus; 14, gracilis; 15, sartorius; 16, inner head of gastrocnemius.

The almost constant failure of osseous union is sometimes owing to the bulging of the synovial membrane between the opposed fragments.

The articulation between the upper extremities of the tibia and fibula is an arthrodial joint, consisting of two opposed articular spaces, united by two ligaments, an anterior and posterior, with a synovial membrane between, *occasionally* communicating with that of the

knee-joint; a circumstance explaining the implication of the synovial membrane of the head of the fibula becoming involved in effusions into the knee-joint.

The *operations* which concern the knee-joint are its excision, entire or partial, and amputation through it.

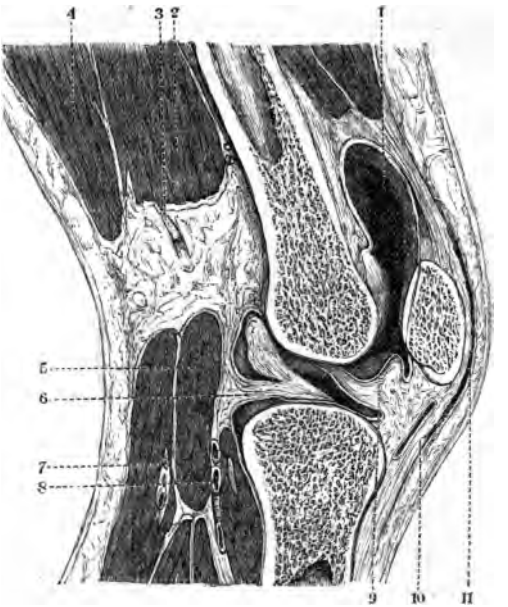


Fig. 66.—Vertical Section of Knee-joint. (One-half.)

1, synovial membrane; 2, short head of biceps; 3, peroneal nerve; 4, long head of biceps; 5, plantaris; 6, external semi-lunar cartilage; 7, sural vessels; 8, popliteal vessels; 9, anterior crucial ligament; 10, ligamentum patellæ; 11, bursa præpatellaris.

Excision of the knee-joint.—The articular surfaces which require removal may be exposed in several ways, the simplest being by a semilunar incision, extending

from the inner side of the inner condyle to the outer side of the external, the convexity of the incision lying midway between the lower border of the patella and the tubercle of the tibia; the joint is thus opened at once. The articular extremities of the femur and tibia, or patella, are to be removed according to circumstances; but in the instance of performing the operation on children, it is of great importance to avoid removing the entire epiphyses, as there would then be no further growth in the limb.

Structures divided in excision of knee-joint.—Integument and aponeurosis, patellar plexus of nerves, bursa patellæ, ligamentum patellæ, anterior part of capsular ligament, synovial membrane, crucial ligaments, lateral ligaments, articular vessels, and articular extremities of femur and tibia. The popliteal vessels are separated from the opened joint by the posterior ligament and popliteus muscle.

SURGICAL ANATOMY OF THE LEG.

The surgical region of the leg commences just below the knee, and extends to an imaginary line drawn round the lower part of the limb, just above the malleoli.

Surface markings.—Its general form is that of an inverted cone, rendering the reflection of the skin difficult in amputation in the lower third. *Anteriorly* is the crest of the tibia, internal to which is the flat plane surface of the shaft of the bone, which being subcutaneous throughout permits of ready examination, and external to it is the mass of the tibialis anticus, and extensors of the toes. *Externally* are the peronei, separated by a well-marked groove corresponding to the interspace between them and the external edge of the soleus. *Posteriorly* is the swell of the calf, due to the gastrocnemius and soleus, the division between the two heads of the former being marked by a furrow

continuous with the lower portion of the popliteal space. As the muscular fibres cease, the tendo-Achillis becomes more evident.

The leg can be readily divided into two regions, an anterior and a posterior, limited by the inner border of the tibia internally and the outer border of the fibula externally.

Anterior region.—The skin is freely moveable over the subjacent tissues, and in the subcutaneous cellular tissue and fat lies the internal saphena vein, which crossing the inner malleolus, passes upwards towards the posterior border of the inner condyle of the femur, and is accompanied by the internal saphena nerve. The *aponeurosis* is the continuation downwards of the fascia lata, strengthened superiorly and internally by the expansion of the sartorius tendon, and thickened inferiorly where it forms the annular ligament of the ankle. It is adherent to the anterior surface of the tibia and external border of the fibula, and sends septa between and gives attachment to the anterior muscles of the limb; it is perforated in several places for the passage of the cutaneous nerves. Enclosed in the space between the aponeurosis the tibia, fibula, and interosseous membrane, lie, the tibialis anticus and the extensor communis digitorum, united superiorly by an intermuscular septum; lower down they separate, and enclose the origin of the extensor proprius pollicis, external to and below which is the peroneus tertius. The space between these muscles and the interosseous membrane is occupied by the anterior tibial vessels and nerve; the nerve, pursuing the same course as the artery, lies at first external to, then upon, and then again outside the vessels.

External region.—The aponeurosis forms an investment for the peronei muscles; the compartment corresponding to the external surface of the fibula. To the upper and middle thirds of this surface the *peroneus longus* is attached; the upper fibres are *pierced by* the external popliteal nerve which at this

it divides into anterior tibial and musculo-cutaus; the latter perforating the fascia about the dle third of the leg. Arising from the middle d of the fibula the peroneus breves is enclosed in same compartment.

he anterior tibial artery.—The course of this vessel

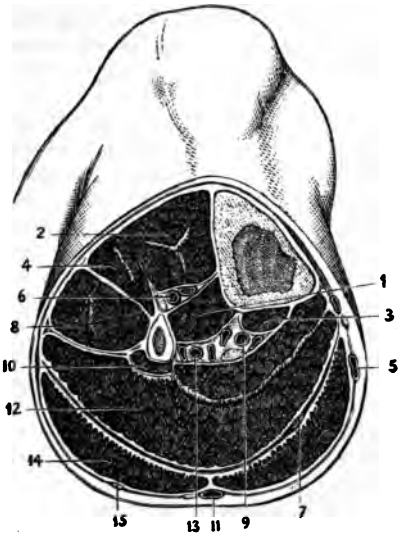


Fig. 67.—Section of the Right Leg in the Upper Third.

ibialis posticus; 2, tibialis anticus; 3, flexor longus digitorum; , extensor longus digitorum; 5, internal saphenous vein; 6, nterior tibial vessels and nerve; 7, tendon of plantaris; 8, eroneus longus; 9, posterior tibial vessels and nerve; 10, exor longus pollicis; 11, external saphenous vein and nerve; 2, soleus with fibrous intersection; 13, peroneal vessels; 14, astrocnemius; 15, communicans peronei nerve.

ndicated by a line drawn from the inner side of the id of the fibula to midway between the malleoli. It ers the region at a point below the popliteus scle, and passes between the upper portion of the

two heads of origin of the tibialis posticus, and comes off from the popliteal almost at a right angle. Its relations are, *anteriorly*, integument and fasciæ, tibialis anticus (above), extensor longus digitorum and extensor proprius pollicis, and the anterior tibial nerve; *internally*, tibialis anticus, extensor proprius pollicis (which crosses it at the instep); *externally*, the anterior tibial nerve, extensor longus digitorum, and extensor proprius pollicis; *posteriorly*, the interosseous membrane, the tibia, and anterior ligament of ankle-joint.

Ligature of this vessel is rarely required, unless it be for a wound, which would be enlarged, and the bleeding points sought for. To tie it an incision should be made in the upper third, in the interspace between the tibialis anticus and the extensor communis digitorum; the intermuscular septum between them looked for, the muscular fibres detached from it, and pulled on one side, when the vessel, surrounded by venæ comites, and having its nerve to the outer side, will be seen lying on the interosseous membrane.

In the *lower* third an incision should be made along the outer border of the tibialis anticus tendon, when the vessel will be found between it and the tendon of the extensor proprius pollicis, and the nerve generally lying on it.

Posterior region. — Beneath the integument and superficial fascia are the external saphena vein and nerve, and some branches of the musculo-cutaneous and internal saphena nerves. The aponeurotic sheath, enclosing that portion of the leg posteriorly between its attachments to the tibia and fibula, is subdivided by an expansion separating the superficial from the deep flexors, vessels, and nerves. The most posterior contains the gastrocnemius and soleus, uniting to form the tendo-Achillis, and the plantaris, with a good deal of fat and bursal tissue. The second, anterior to the former, contains the flexor longus digitorum internally, the flexor longus pollicis externally, and tibialis pos-

ticus muscles between them, closely united by intermuscular septa. The posterior tibial vessels on the tibial side, having the posterior tibial nerve external to them, and the peroneal vessels on the fibula, lying at first beneath the intermuscular aponeuroses, next between the flexor longus pollicis and tibialis posticus, and lower down the limb, between the tibialis posticus and the fibula.

The posterior tibial artery would rarely require ligature in its upper third, unless for injury, in which case the wound should be enlarged, and the bleeding point secured. If the vessel be divided by a punctured wound from the front of the leg, or in the case of traumatic aneurism of the vessel, low down, it is necessary to place a ligature upon it in this situation.

Ligature of the posterior tibial artery in the upper third.—This vessel is reached most scientifically by an incision made along the posterior border of the subcutaneous surface of the tibia, about four inches in length, dividing the integument and aponeurosis, taking care to avoid the internal saphena vein and nerve. The inner border of the gastrocnemius is to be drawn aside; when the tibial head of the soleus is reached, its fibres are to be divided, until the intermuscular septum (the position of which is variable) is come upon. This is next to be cut through, and the fibres of this muscle divided until freedom of access is obtained. The cut edges of the soleus are to be separated, the smooth intermuscular aponeurosis which separates the superficial from the deep flexors is to be divided on a director, and the posterior tibial nerve drawn on one side; the posterior tibial artery, surrounded by venæ comites, is seen lying on the flexor longus digitorum.

The nutritious artery is a branch of considerable importance. Directed upwards towards the knee, it enters the shaft of the tibia in a deep canal in the posterior *aspect, about* four fingers' breadth from the

knee, and may give rise to troublesome hæmorrhage in amputation of the leg at this part.

The peroneal artery, generally regarded as a branch of the posterior tibial, is very often of larger size. It is very deep, and lying along the fibular surface of the leg, has the following relations:—*In front*, the tibialis posticus and flexor longus pollicis; *externally*, the fibula; and behind, the soleus, deep aponeurosis, and flexor longus pollicis. This vessel is occasionally wounded in compound comminuted fractures of the fibula.

In fractures of the tibia, which take place *obliquely* from above, downwards, and forwards, the muscles of the calf cause the lower fragments to be drawn upwards and backwards, and frequently the upper one to protrude through the integument. With a view of bringing the surfaces into apposition, the knee should be bent to relax the opposing muscles, and extension made from the knee and ankle (*vide* "Ankle-Joint"). Occasionally, the V or screw fracture is met with—the result of a wrench.

Fracture of the lower end of the fibula is usually associated with fracture of the inner malleolus (Pott's fracture), or rupture of the internal lateral ligament of the ankle-joint, causing dislocation of the foot outwards. The eversion of the foot is due to the action of the peroneus longus, whilst the heel is drawn upwards by the gastrocnemius and soleus. The reduction is effected by flexing the leg at right angles with the thigh, and making extension from the knee and ankle.

The relation of the tibia and fibula to each other must be borne in mind in performing amputation through the leg. The fibula lies on a plane posterior to the tibia, and its external border, with about half of its external surface, is situated behind the interosseous ligament; hence, unless care be taken, the knife may be easily entered between the bones, instead of taking *the necessary* oblique course skirting their posterior *surfaces.*

Structures divided in the double flap amputation through the calf.—In the *anterior* flap: the integument, cutaneous nerves, aponeurosis, tibialis anticus, extensor communis digitorum, and extensor proprius pollicis, peroneus longus and brevis, musculo-cutaneous nerve, anterior tibial vessels and nerve. In the *posterior*, the flexor longus digitorum, flexor longus pollicis and tibialis posticus, posterior tibial vessels and nerve, peroneal vessels, intermuscular aponeurosis, soleus and plantaris, gastrocnemius, external saphena nerve and vein, internal saphena vein and nerve, aponeurosis and integuments.

SURGICAL ANATOMY OF THE TIBIO-TARSAL REGION.

Ankle or malleolar region.—It has been thought more convenient to postpone the description of the several articulations entering into the conformation of the foot and ankle until all those soft structures which enclose them have been explained; as all surgical reference to the skeleton must necessarily be made from the surface, it is of importance that all the intermediate parts be demonstrated from without inwards, and in the order they would be met with in an operation.

Surface markings.—This region includes the ankle-joint, and the structures immediately surrounding it, and offers for examination two surfaces, an anterior and a posterior.

Anterior surface.—The two malleoli, of which the internal is the shorter and broader, and the external set more backwards and longer, enclose a space through which pass the extensors of the foot and toes, which are rendered evident by their several movements. Beneath the integument and superficial fascia lie internally, just in front of the malleolus, the internal saphena vein, accompanied by its nerve; more externally the musculo-cutaneous nerve; whilst passing from behind the outer malleolus is the external saphena nerve. The aponeurosis is a strengthened continuation of that of the

leg, attached intimately to the malleoli, consisti
superior fasciculus, which binds down the su
tendons, just in front of the extremities of th
and fibula, and an inferior, which retains them
nexion with the tarsus. It forms two distinct
commencing internally—1, for the tendon
tibialis anticus; 2, for the tendon of the e
longus digitorum, peroneus tertius, and e
proprius pollicis, beneath which is the anteric
vessels and nerve. These sheaths are lined wit
rate synovial membranes. The hollows immedi
front of the malleoli correspond with the artic
and disappear when the synovial membrane
tended.

The posterior surface, or that portion behi
malleoli, is separated by the tendo-Achillis in
hollows.

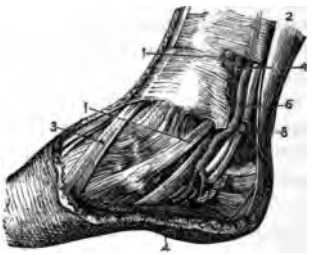


Fig. 68.—Relations of parts behind the Inner Malle
1, 1, tibialis posticus; 2, tendo-Achillis; 3, tibialis antic
flexor longus digitorum; 6, posterior tibial artery; 8,
tibial nerve. The tendon of the flexor longus pollic
deeply placed to be shown in this view.

In the *outer*, beneath the integuments, is
ternal saphena vein and nerve, lying upon the
annular ligament, which is attached to th
malleolus and outer surface of the os calcis,
down the peroneus longus and brevis, the forme
the superior; they are contained in a common
(at first), and have a common synovial membra

hollows immediately behind the malleoli, and separated by the tendo-Achillis, do not become obliterated by distension of the synovial membrane of the ankle-joint.

In the *inner*, the pulsations of the posterior tibial artery are plainly seen or felt, and beneath the integument are the internal saphena vein and nerve, which lie upon the internal annular ligament, which is attached to the inner malleolus and inner surface of the os calcis, and forms with the tibia, os calcis, and astragalus a series of separate canals, containing from before backwards the tendons of the tibialis posticus; the flexor longus digitorum; the posterior tibial vessels and nerve, running in a sheath of their own derived from the contiguous septa; the flexor longus pollicis, the canal of which is formed partly by the astragalus. Each of these canals has a separate synovial membrane. The tendo-Achillis has a separate sheath derived from this aponeurosis.

The posterior tibial artery at the ankle-joint lies between the flexor longus digitorum and the flexor longus pollicis tendons, having venæ comites on each side, and the posterior tibial nerve behind it.

Ligature of the posterior tibial artery at the inner malleolus.—This vessel is easily reached, but the incision must be made carefully, as there is a risk of dividing it in overcoming the resistance of the internal lateral ligament. An incision about two inches and a half in length is to be made through the integument, midway between the inner malleolus and the tuberosity of the os calcis. After the dense aponeurosis is exposed it should be cautiously divided, when the vessel will be seen surrounded by venæ comites, and in order to avoid the nerve, which lies *posteriorly*, the needle should be passed *from the heel towards the ankle.*

The *structures immediately in relation with the ankle-joint* are, *anteriorly*, the tendons of the extensor longus digitorum and peroneus tertius, the extensor proprius pollicis, anterior tibial vessels and nerve, the

tendon of the tibialis anticus; *posteriorly*, tendons of the peroneus longus and brevis, the flexor longus pollicis, the posterior tibial vessels and nerve, the tendons of the flexor longus digitorum and tibialis posticus.

The joint is formed by the articulation of the inferior articular extremities of the tibia and fibula with the astragalus.

The tibio-tarsal articulation.—The extremities of the tibia and fibula are hollowed out into a sort of mortice, concave from before backwards, open in front and behind, and shut in laterally by the malleoli.

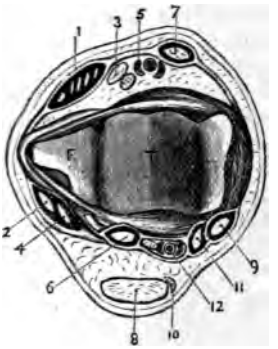


Fig. 69.—Transverse Section of the Right Ankle-joint.

1, extensor longus digitorum and peroneus tertius; 2, peroneus longus; 3, extensor proprius pollicis; 4, peroneus brevis; 5, anterior tibial vessels and nerve; 6, flexor longus pollicis; 7, tibialis anticus; 8, tendo-Achillis; 9, tibialis posticus; 10, plantaris; 11, flexor longus digitorum; 12, posterior tibial vessels and nerve.

The use of the malleoli is to prevent lateral movements, and to restrict the motions of the joint to flexion and extension. The articular surface of the astragalus presents superiorly a surface convex from before backwards for the corresponding articular surface of the tibia; laterally are two articular surfaces corresponding with those of the malleoli, the external

one being the larger. The *ligaments* are an external lateral, consisting of three fasciculi; an internal, or deltoid, radiating from the inner malleolus, to be attached to the scaphoid, os calcis, and astragalus; anteriorly are a few fibres closing in the articulation; posteriorly the joint is shut in by the transverse ligament of the inferior tibio-fibular articulation. The synovial membrane invests the inner surface of the ligaments and articular cartilages, and owing to the

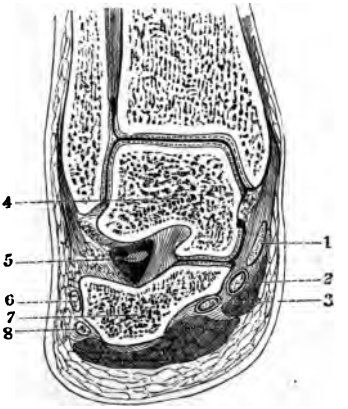


Fig. 70.—Vertical Section of Ankle-joint. (One-half.)

1, tibialis posticus; 2, flexor longus pollicis; 3, flexor longus digitorum; 4, astragalus; 5, astragalo-calcaneum ligament; 6, peroneus brevis; 7, os calcis; 8, peroneus longus.

great laxity of the anterior and posterior ligaments it readily bulges through them, consequently the joint is easily reached from either aspect, and in cases of synovitis the membrane usually protrudes in front between the malleoli and again behind the external malleolus.

Dislocation at the tibio-tarsal articulation—that is to say, dislocation of the entire foot from the bones of the *leg—is almost* invariably associated with fracture

of one or other malleoli, which can be readily understood from the shape and extent of motion allowed at the joint. It is a result of the foot being twisted in running or walking, and may either be *outwards*, when the lower end of the fibula is broken, the inner malleolus or internal lateral ligament torn; *inwards*, when there is no fracture of the fibula, but the lower end of the tibia broken; *backwards*, when both malleoli are broken, the heel projecting; and *forwards*, when the astragalus is thrown in front of the tibia.

Excision of the ankle-joint.—The seat of disease can be reached by a variety of incisions; but the object to be attained is to save the tendons, in order

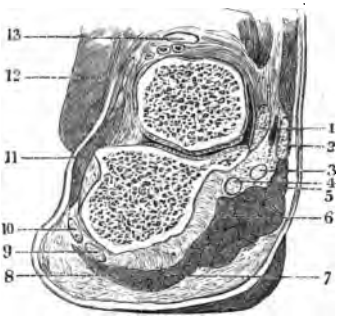


Fig. 71.—Vertical Section through the Anterior Astragalo-calcanean Articulation. (One-half.)

1, internal lateral ligament; 2, tibialis posticus; 3, flexor carpus pollicis; 4, flexor carpus digitorum; 5, abductor pollicis; 6, flexor accessorius; 7, flexor brevis digitorum; 8, abductor minimus digiti; 9, peroneus longus; 10, peroneus brevis; 11, extensor brevis digitorum; 12, extensor communis digitorum; 13, extensor longus pollicis.

that they may still fulfil their functions as far as possible, for which purpose an accurate knowledge of the parts in contact with the articulation is necessary, *and which* may be gathered from a study of the *accompanying* sections.

The articulation of the astragalus with the os calcis is one of great strength, owing to the interosseous ligament which lies in the grooves of these bones; it is ruptured in cases of dislocation of the astragalus from the os calcis. This is by far the most important of the luxations of the tarsal bones, and may occur either forwards and inwards, or forwards and outwards.

Amputation at the ankle-joint.—The landmarks for the guidance of the knife are, in the first place, for the *anterior flap*, the two malleoli, which are to be united by a semilunar incision dissected forwards; and for the *posterior*, one cutting the sole transversely and a little obliquely forwards, and extending between the limits of the preceding incision; the articulation is next opened, the lateral ligaments divided, the posterior part of the capsule cut through, and the os calcis sawn through obliquely from behind forwards and downwards. The anterior flap is dissected off the malleoli, which are next sawn off, and the cut surfaces approximated, and the tendo-Achillis, if necessary, divided. (Pirogoff.) Syme's amputation consists in removing the os calcis, and sawing off the ends of the malleoli. In both these operations care must be taken not to wound the trunk of the posterior tibial artery, and to keep the external and internal plantar vessels as long as possible.

SURGICAL ANATOMY OF THE FOOT.

TARSO-METATARSAL REGION.

The dorsum of the foot.—The chief points to be observed in the surface markings of the dorsum of the foot are those connected with the prominent points of its skeleton. For the performance of the several amputations and disarticulations, certain landmarks are necessary to guide the operator in finding the articulation he desires to open. Thus, a line drawn from *the depression* on the inner side of the foot,

between the inner cuneiform bone and the great toe, to the posterior edge of the tuberosity of the fifth metatarsal bone, indicates the course of an incision, such as would expose the tarso-metatarsal articulation.

Again, the tubercle of the scaphoid on the inner side, and a point midway between the outer malleolus, and the tuberosity of the fifth metatarsal bone, which is the situation of the articulation between the cuboid and os calcis, indicates a line of incision which would open the medio-tarsal joint.

Topography.—First, the integument, and subcutaneous cellular tissue, which contains the dorsal venous arch, the terminal inosculation of the internal and external saphena, and the musculo-cutaneous nerves, beneath which is the dorsal aponeurosis of the foot, and from within outwards the tendons of the tibialis posticus, tibialis anticus, extensor proprius pollicis, extensor communis digitorum, peroneus tertius, and peroneus brevis, and in a plane beneath them the extensor brevis digitorum; externally, the dorsalis pedis vessels and anterior tibial nerve, the tarsal and metatarsal branches of the anterior tibial artery and external branch of the anterior tibial nerve, which latter lie beneath the lesser extensor muscle. All these structures lie close upon the tarsus and metatarsus, and between the metatarsal bones the dorsal interossei are seen bulging through.

The *dorsalis pedis artery* is the continuation of the anterior tibial, and passes forwards on the tibial side of the foot to the inner interosseous space, where it divides into the dorsalis hallucis and the perforating vessels which enter the sole between the heads of the first dorsal interosseous muscle. It is in *relation* in front with the integument and fascia, and inner tendon of the extensor brevis digitorum; internally with the extensor proprius pollicis; externally with the extensor longus digitorum and anterior tibial *nerve; posteriorly* with the astragalus, scaphoid, inner *cuneiform*, and with the ligaments attached to them.

Ligature of dorsalis pedis artery.—The course of this vessel is indicated by a line drawn from the middle of the inter-malleolar space to the first inter-osseous space. It is superficial, but is bound down by a very dense aponeurosis, which must be divided cautiously to avoid injuring the artery beneath. An incision is to be made over the instep along the outer border of the extensor proprius pollicis, when the vessel will be found lying in a triangular interspace formed by the outer border of the extensor proprius pollicis internally, by the inner tendon of the extensor brevis externally, and by the fleshy fibres of the extensor brevis digitorum, posteriorly. The nerve lies to its outer side.

PLANTAR REGION.

Topography.—Beneath the integument, which is very thick and strong, the first tissue met with is a dense layer of fat, in which are three bursæ, one beneath the os calcis, and two beneath the heads of the first and fifth metatarsal bones. Ramifying in the fat are some cutaneous branches of the cutaneous nerves of the foot, some perforating branches of the plantar vessels, and a great number of lymphatics. The next layer is formed by the plantar fascia, consisting of three portions, of which the central is the strongest, sending down processes which enclose the several muscles, separating the middle from the external and plantar internal groups. This fascia divides opposite the middle of the metatarsus into five processes, each one of which again divides opposite the metatarso-phalangeal joint into two slips, which by their deep attachments form arches for the passage of the flexor tendons to the toes; and the interspaces allow of the digital vessels and nerves, the tendons of the lumbricales and interossei becoming superficial. The mutual relations of the structures forming the sole of the foot can be conveniently referred to the partitions thus formed by *the plantar fascia.*

In the inner compartment, internally and posteriorly, lie the fleshy fibres of the abductor pollicis, the tendons of the flexor longus digitorum and flexor longus pollicis, the latter crossing and becoming internal anteriorly, the posterior tibial vessels and nerves becoming plantar, flexor brevis pollicis, the vessels and nerves of the great toe and inner side of the foot.

In the outer compartment lie the abductor minimi digiti and the flexor brevis minimi digiti.

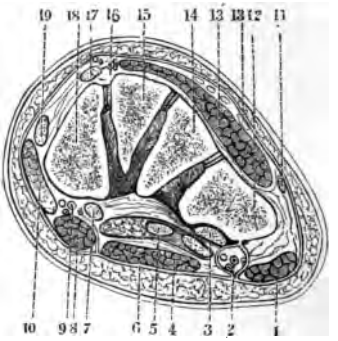


Fig. 72.—Vertical Section through the Cuneiform and Cuboid Bones. (One-half.)

1, abductor minimi digiti; 2, external plantar vessels and nerve; 3, tendon of peroneus longus; 4, flexor brevis digitorum; 5, flexor longus digitorum; 6, plantar fascia; 7, flexor longus pollicis; 8, 10, abductor pollicis; 9, internal plantar vessels and nerve; 11, peroneus tertius; 12, cuboid; 13, dorsal aponeurosis; 14, external cuneiform; 15, middle cuneiform; 16, dorsalis pedis vessels and nerve; 17, exterior longus pollicis; 18, internal cuneiform; 19, tibialis anticus.

The middle compartment, which is by far the most important from its contents and size, is bounded by the plantar fascia below, laterally by the septa between the outer and inner compartments, and its roof is formed by the under surfaces of the bones forming the arch of the foot; it communicates posteriorly with the region of the leg by means of the sheaths for the tendons and vessels passing beneath the inner

malleolus. Beneath the middle fasciculus of the plantar fascia, lie the flexor brevis digitorum, the plantar vessels and nerves, the flexor accessorius, the tendons of the flexor longus digitorum, with which are associated the lumbricales, and flexor longus pollicis internally. Beneath these muscles lie posteriorly the tarsal bones and their ligaments; anteriorly, the adductor pollicis, the heads of the metacarpal bones and the ligaments uniting them, the transversus pedis, the plantar arch and external plantar nerve and their interosseal branches, the bodies of the metacarpal

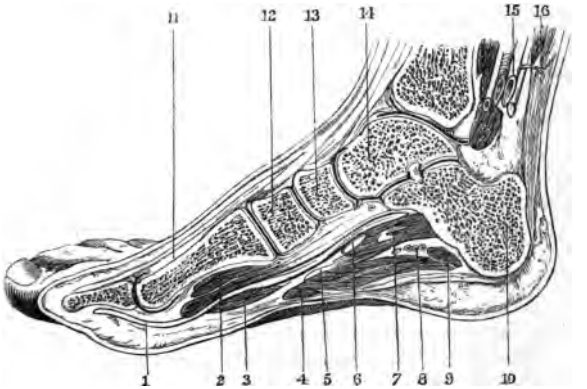


Fig. 73.—Longitudinal Section of Foot. (One-third.)

1, flexor longus pollicis; 2, flexor brevis pollicis; 3, lumbricalis; 4, flexor brevis digitorum; 5, internal plantar nerve; 6, flexor communis; 7, accessorius; 8, external plantar vessels and nerve; 9, adductor minimi digiti; 10, os calcis; 11, extensor proprius pollicis; 12, internal cuneiform; 13, scaphoid; 14, astragalus; 15, posterior tibial vessels and nerve; 16, tendo-Achillis.

bones, between which lie the plantar interossei, and lying deeply in the tarsus the tendon of the peroneus longus.

Club-foot (talipes.)—The various deformities of the foot, occurring at the tibio-tarsal or medio-tarsal arti-

culations, which are within the operative interference known as tenotomy, are—*talipes equinus*, in which the heel is raised so that the individual walks on the ball of the foot, in which case the tendo-Achillis requires division; *talipes varus*, or more precisely talipes equino-varus, where the heel is raised, the foot turned inwards for about the anterior two-thirds—this inversion taking place at the astragalo-scaphoid and calcaneo-cuboid articulations, its dorsal aspect outwards, and the inner edge drawn up; the tendons requiring division being—the tendo-Achillis, and the tendons of the tibialis posticus, anticus, and flexor longus digitorum; *talipes valgus*, where the inner ankle is towards the ground and the outer edge of the foot turned up; the tendons to be divided are—the peronei, and the extensor longus digitorum, and the plantar fascia; *talipes calcaneus*, where the patient walks on the heel—a case requiring division of the tendons of the tibialis anticus, extensor communis digitorum, extensor proprius pollicis, and peroneus tertius. There are several intermediate forms; and talipes equinus and varus are usually associated, on account of the extensor and peronei muscles being supplied by the anterior tibial and musculo-cutaneous nerve. Talipes calcaneus and valgus are generally associated.

The tibialis posticus tendon can be divided by *tenotomy*, either above or below the ankle. The point selected *above* the ankle is on the posterior margin of the tibia about an inch or so above the malleolus, where it lies in the groove in its own sheath and in contact with the bone; eversion of the foot raises the tendon *below* the ankle, at its insertion into the scaphoid. The point is just above the astragalo-scaphoid articulation, which is immediately behind the first tuberosity met with in passing the finger along the inner side of the foot, starting at the malleolus. The tibialis anticus not being so confined as the preceding can be more readily put on the stretch, as it passes over the lower end of the tibia in the innermost compartment of the

annular ligament. It may be also divided at its insertion into the inner cuneiform bone, the position of which attachment may be ascertained by passing the finger along the inner surface of the foot, when it is just in front of the articulation of the scaphoid with the inner cuneiform.

In performing the *tarso-metatarsal disarticulation*, known as Hey's or Lisfranc's, the line of the joints may be exposed, in the first place, by starting from the outer surface of the foot at a point immediately behind the tuberosity of the fifth metatarsal bone to a

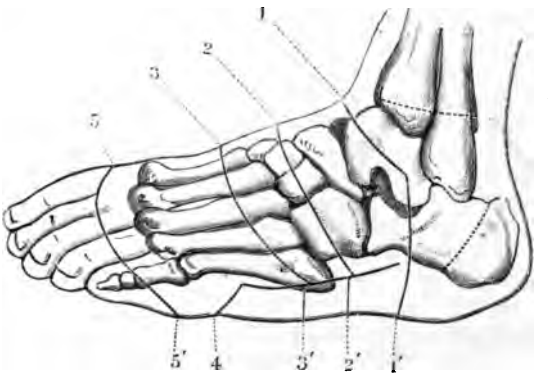


Fig. 74.— Diagram of the Lines of Incision in

1, 1', Pirogoff's amputation; 2, 2', Chopart's; 3, 3', Hey's; 4, limit of posterior flap in the two latter; 5, 5', dorsal flap in amputation of tarsal bones.

point which may be indicated in one of the following ways:—(1) If a transverse line be drawn across the foot from the tuberosity of the fifth metatarsal bone, it falls on the inside of the foot, two-thirds of an inch *behind* the required spot; (2) in following the inner edge of the foot from behind forwards, an inch in front of the malleolus is the projection of the scaphoid; the *joint between* the great toe and the tarsus is one

inch *in front* of this. The articulation of the first metatarsal bone with the inner cuneiform is oblique from within outwards, and about a quarter of an inch in front of the third. The line of the joint is rendered irregular by the jutting into the tarsus of the second metacarpal bone, which is wedged in between the inner and outer cuneiform bones, its line of articulation lying about half an inch behind the anterior articular surface of the inner cuneiform, and about a quarter of an inch behind the anterior articular surface of the outer cuneiform bone. The joint of

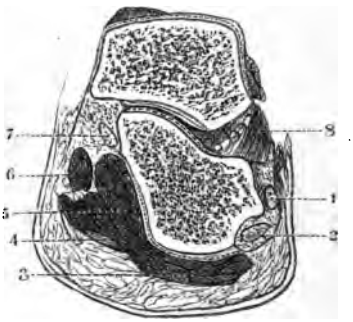


Fig. 75.—Vertical Section through the Posterior Astragalo-calcanean Articulation. (One-half.)

1, peroneus brevis; 2, peroneus longus; 3, abductor minimi digiti; 4, plantar fascia; 5, flexor accessorius; 6, abductor pollicis; 7, flexor longus digitorum.

the third with the internal cuneiform is almost transverse; that of the fourth is curved; and that of the fifth with the cuboid is doubly oblique. After disarticulation, the posterior flap should extend as far as the web of the toes.

Structures divided in Hey's amputation.—In the *anterior* flap, the integument beginning from the outer side, the dorsal veins of the foot, the internal and external divisions of the musculo-cutaneous nerve, the internal and external cutaneous nerves, the dorsal

aponeurosis, extensor brevis digitorum, tendon of peroneus brevis, tendon of extensor communis digitorum, dorsalis pedis vessels and accompanying nerve, tendons of extensor proprius pollicis and tibialis anticus, dorsal ligaments, and the articulation.

In the *posterior* flap, plantar ligaments, tendon of peroneus longus, external and internal plantar vessels and nerves, interossei, the flexor brevis, abductor and adductor pollicis, transversus pedis, tendons of long and short flexors of toes, and flexor longus pollicis tendon, digital vessels and nerves, plantar fascia and integument.

Chopart's amputation, or the medio-tarsal, consists of opening the articulation by a semilunar incision, extending between the joint behind the tubercle of the scaphoid internally and a point midway between the external malleolus and the tuberosity of the fifth metatarsal bone; externally, the lower flap is to be brought well up to the web of the toes.

It is important to remember that the direction of the articulating surface is changed in flexion or extension: in flexion the astragalus and calcis are in the same line, in extension the calcis is at least a quarter of an inch in front; the head of the astragalus presents a large globular surface, whilst the anterior articulating surface of the calcis is concave.

The following directions for finding the articulation with readiness are useful. *To find its internal side*, follow the inner edge of the foot with the finger; the first tuberosity met with is the scaphoid; the joint is immediately behind it. For the *external side*, pass the finger along the outer edge of the foot from the external malleolus; the articulation is immediately in front of the first tuberosity met with, which belongs to the os calcis. To complete the line of the articulation extend the foot and abduct it; then, applying the finger on the union of the external with the middle third of the intermalleolar space, the first eminence met with in proceeding forwards is the head of

the astragalus; immediately in front of this is the articulation.

Structures divided in Chopart's amputation.—Commencing from the inner side, the *anterior flap*, that is, up to the point of disarticulation, will contain integument, saphena vein, and musculo-cutaneous nerve, anterior annular ligament, tendon of tibialis anticus, extensor proprius pollicis, anterior tibial nerve and vessels, tendons of common extensor and peroneus tertius, extensor brevis digitorum, peroneus brevis and anterior ligaments of the articulation; the *posterior* flap should contain the posterior ligaments of the articulation, the tendon of the tibialis posticus, flexor longus digitorum and flexor longus pollicis, some branches of the internal plantar nerve and vessels, the abductor pollicis, the flexor accessorius, the tendon of the peroneus longus, the abductor minimum digiti, the flexor brevis digitorum, the external plantar nerve and vessels, and the integument of the sole.

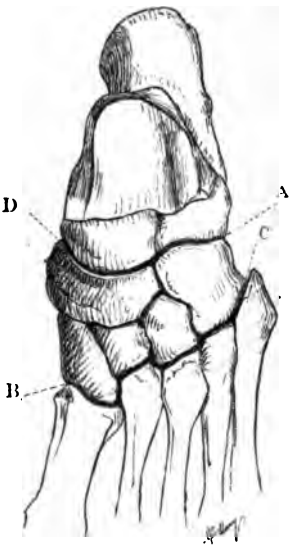


Fig. 76.

A, line of Chopart; B, line of Hey; C, tubercle of fifth metatarsal; D, tubercle of scaphoid.

Synovial membranes of the tarsus and metatarsus.—There are four synovial membranes in the articulations of the tarsus—namely, one for the posterior calcaneo-astragaloid articulation, a second for the anterior *calcaneo*-astragaloid and astragalo-scaphoid, a third for

the calcaneo-cuboid, and a fourth for the surfaces of the cuneiform with the scaphoid, the cuneiform with each other, the external cuneiform with the cuboid, and the middle and outer cuneiform with the second and third metatarsal bones. Between the internal cuneiform and the base of the metatarsal bone of the great toe there is a single synovial membrane, and there is another common to the anterior surface of the cuboid, and the bases of the fourth and fifth metatarsal bones.

The arteries of the sole of the foot are the internal and external plantar; the internal commences at about the centre of the inner aspect of the os calcis, and courses forwards between the muscles of the inner and middle groups, anastomosing with the malleolar and dorsalis pedis. The external is much larger, and forms the plantar arch. Commencing at the same spot as the internal, it passes obliquely forwards and outwards, lying at first between the os calcis and abductor pollicis, and then between the flexor accessorius and flexor brevis, and forming a curve, the convexity of which is forwards, it joins, at the interval between the first and second metatarsal bones, the perforating branch of the dorsalis pedis, thus completing the plantar arch. Its branches are muscular, perforating, which inosculate with those of the metatarsal artery, and digital, which supply the three outer toes and half the second.

The nerves are the internal and external plantar branches of the posterior tibial, of which the internal is considerably the larger.

Toes.—The description already given of the fingers will in almost every particular suffice for that of the toes.

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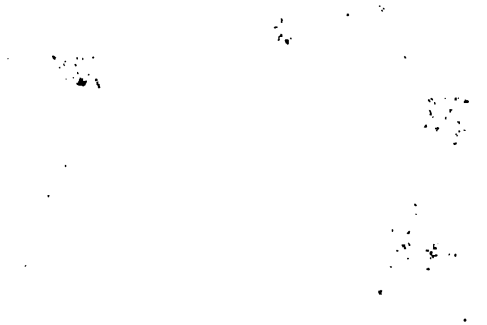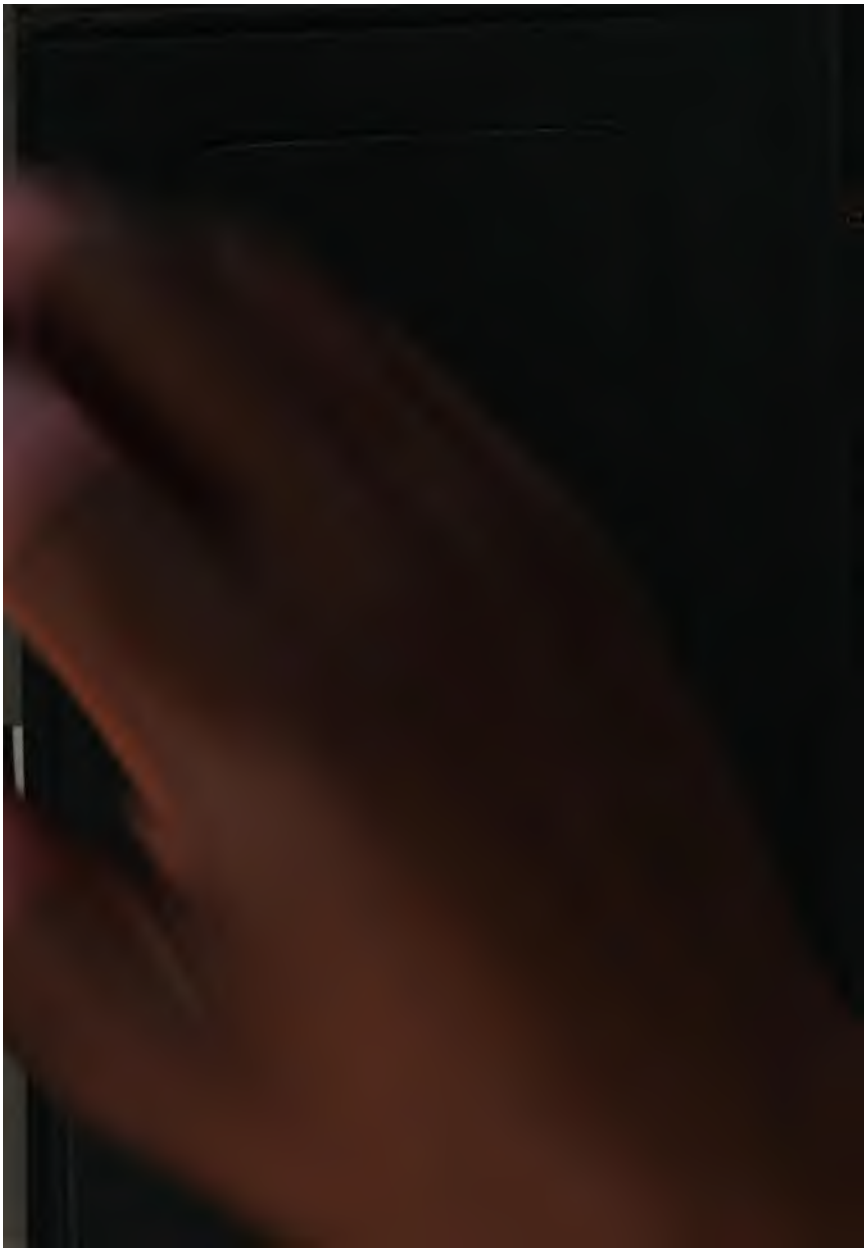
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